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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 15, NUMBER 8
AUGUST 1, 1982

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UNIVERSITY OF ILLINOIS
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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Office of Water Research and Technology,
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VOLUME 15, NUMBER 8
AUGUST 1, 1982

W82-03401 -- W82-03750

The Secretary of the Interior has determined that the publication of the perlodical Is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

SURFACE VISCOSITY OF WATER,
Queen's Univ., Belfast (Northern Ireland). Dept. of Pure and Applied Physics.
J. C. Earnshaw.
Nature (London), Vol 292, No 5819, p 138-139, July 9, 1981. 2 Fig, 10 Ref.

Descriptors: *Viscosity, *Physical properties, *Interfaces, *Fluid mechanics, Air-water interfaces, *Surface tension, Mathematical equations, Capillary waves, Waves, Molecular structure.

Recent reports by Goodrich have shown that the molecularly diffuse region between two fluids displays anisotropic momentum transport parallel to and normal to the interface. This anisotropy leads to surface viscosity effects, two of which describe dilational viscosity within and normal to the interface and two describe shear viscosity. Earlier studies have shown that the propagation of capillary waves on the surface of water is not compatible with the predictions of accepted theory for a surface having no abnormal rheological properties. These apparent discrepancies can be resolved in terms of one of the surface shear viscosities predicted by Goodrich. The existence of such surface viscosities for pure water suggests that caution must be exercised in interpreting surface viscosities observed for surface films in terms of molecular structure of, or interactions within, the films. (Carroll-FRC)
W82-03501

FUNCTIONAL RELATIONS BETWEEN GENERAL CHARACTERISTICS OF ORGANIC MATTER IN NATURAL WATERS,
Akademiya Nauk SSSR, Moscow. Inst. Biologii Vnutrennykh Vod.
E. S. Bikbulatov.
Water Resources, Vol 8, No 1, p 53-61, January/February, 1981. 3 Tab, 22 Ref. Translated from Vodnye Resursy, No 1, p 117-127, January/February, 1981.

Descriptors: *Organic matter, *Oxidation, *Chemical oxygen demand, Biological oxygen demand, Oxygen equivalent, Humic acids, Thermodynamics, *Natural waters.

Some of the indices used to describe organic matter in natural waters are elemental and general biochemical composition, oxygen equivalent, ratios of different organic elements, degree of oxidation, stored energy, COD, and BOD. Equations are proposed to relate these known indices to each other. The relationship of average valence of C to oxygen equivalent is revealed. Three types of oxygen equivalent (two new) are established. Formulas are presented for calculating oxygen equivalent from biochemical and elemental analyses. Errors in previous investigations are pointed out and true values of oxygen equivalent given. Expressions are provided to describe energy storage of organic matter with respect to the easily determined parameters, bichromate oxidizability and organic nitrogen content. (Cassar-FRC)
W82-03573

1B. Aqueous Solutions and Suspensions

THE CALCULATION OF ION PAIR DIFFUSION COEFFICIENTS: A COMMENT,
California Univ., Santa Barbara. Marine Science Inst.
K. S. Johnson.
Marine Chemistry, Vol 10, No 3, p 195-208, April, 1981. 1 Fig, 6 Tab, 37 Ref.

Descriptors: *Diffusion coefficients, *Ions, *Electrolytes, Salts, Seawater, Molecular diffusion, Mass transfer, Soil chemistry, Ion transport, Ion exchange.

The values of the diffusion coefficients of MgSO4 ion pairs computed by Harned and Hudson (1951) and Katz and Ben-Yaakov (1980) are too high by a factor of two. The correct value of the ion pair diffusion coefficient at infinite dilution was obtained from the measured mutual diffusion coefficient after applying corrections for incomplete dissociation, the electrophoretic effect, the viscosity of the solution, and the effect of chloride ion pairs. Diffusion coefficients were calculated for the following (all values multiplied by 10 to the minus 5th power): NaSO4(-), 0.81; CaCl(+), 0.78; BaCl(+), 0.85; NaCl, 0.86; KCl, 1.09; NH4Cl, 1.10, and CsCl, 1.27. Diffusion coefficients are generally less than those of the free ions. (Cassar-FRC)
W82-03487

COMPARISON OF FIVE DIFFERENT METHODS FOR MEASURING BIODEGRADABILITY IN AQUEOUS ENVIRONMENTS,
Battelle Columbus Div., OH.
J. L. Means, and S. J. Anderson.
Water, Air, and Soil Pollution, Vol 16, No 3, p 301-315, October, 1981. 5 Fig, 20 Ref.

Descriptors: *Biodegradation, *Organic compounds, Degradation, Ethylene glycol, Benzaldehyde, Aniline, Nitrilotriacetic acid, Nitrophenol, *Fate of pollutants, Biochemical tests, Microbial degradation, Biological oxygen demand, Shake flask test, Carbon dioxide evolution test, Gledhill test, Activated sludge test, Comparison studies, Technology, Analytical techniques.

Five methods for measuring biodegradability (BOD, Shake Flsk, CO2 Evolution, Activated Sludge, and Gedhill, which combines aspects of Shake Flask and CO2 Evolution) were tested using aqueous solutions of aniline, benzaldehyde, ethylene glycol, nitrilotriacetic acid, and p-nitrophenol. The BOD test used concentrations of 1, 2, 4, 8, and 16 ppm; shake test, 20 ppm as organic carbon; CO2 evolution, 10 ppm; activated sludge, 50 or 100 ppm as organic carbon; and Gledhill, 20 ppm as organic carbon. Aniline, benzaldehyde, and ethylene glycol degraded rapidly in all tests. Nitrilotriacetic acid was the slowest biodegrader, and p-nitrophenol was the second slowest. These two compounds behaved variably, according to the test used. Compounds which degrade in the activated sludge and Gledhill tests may not behave similarly in the natural environment. (Cassar-FRC)
W82-03557

2. WATER CYCLE

2A. General

SOME SUSPENDED SEDIMENT YIELDS FROM SOUTH ISLAND CATCHMENTS, NEW ZEALAND,
Ministry of Works and Development, Christchurch (New Zealand). Water and Soil Div.
For primary bibliographic entry see Field 2J.
W82-03411

WATER LOSS EQUATIONS AND COEFFICIENTS TO ESTIMATE RUNOFF FROM RAINFALL,
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering.
N. Foroud, and R. S. Broughton.
Water Resources Bulletin, Vol 17, No 3, p 387-393, June, 1981. 5 Fig, 4 Tab, 10 Ref.

Descriptors: *Infiltration, *Soil moisture, *Antecedent precipitation index, *Rainfall-runoff relationships, Model studies, Small watersheds, Watersheds, Storms, Excess rainfall.

A computer simulation model for flood runoff systems known as the FH-Model was used to analyze rainfall-runoff data from 39 storms on four small watersheds (17 to 342 sq km) in the Yamaska River Basin, Quebec. The loss parameters A (initial loss rate, cm per hour) and B (for a given soil and initial conditions, liters per hour) were obtained. These parameters were related to the antecedent precipitation index by equations. Using the data from 11 storms in a nearby watershed, the equations produced results in which seven points agreed within less than 10% and four points had errors of 10-40%. All these four storms occurred after a dry period in which soil moisture remained reasonably high. (Cassar-FRC)
W82-03441

RUNOFF PREDICTION AND RAINFALL UTILIZATION IN THE SEMI-ARID TROPICS,
Utah State Univ., Logan. Dept. of Engineering.
J. H. Krishna.
PhD Thesis, 1979. 160 p, 24 Fig, 9 Tab, 77 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-19256.

Descriptors: *Rainfall, *Runoff, *Prediction, Watersheds, *Model studies, Land management, Water management, Semiarid lands, Soil water, Tropical regions, Storm runoff, *Small watersheds, *India.

A parametric simulation model was developed to predict storm runoff volumes from small watersheds. It has minimal input data requirements which include daily rainfall amount, storm duration or rainfall intensity, and pan evaporation data. There are only two parameters (related to infiltration) which are determined through an optimization procedure during the calibration process. Hydrologic data was used from three small research watersheds with different land management treatments, located at ICRISAT, Hyderabad, India. A high degree of correlation was obtained between computed and measured runoff volumes in all cases. The model also simulated very well the variation in soil moisture during the test period. It was shown, by using data from another distantly located watershed that the parameter values for the model were transferable. When hydrologic data is not available for calibration purposes, initial estimates of the parameters can be made to provide preliminary runoff estimates even for a new location. The model was shown to be transferable not only to similar sites, but with proper judgment in selecting parameter values, to new locations as well. The water balance computations of the model were used to determine the effective rainfall under traditional and improved methods of land and water management for crop production in India. It was shown that effective rainfall could be increased three-fold by the adoption of improved land and water management technology. Actual yield data was used to show that significantly higher rainfall productivities than those at the present time, can be achieved. (Sinha-OEIS)
W82-03502

SIMULATION OF SOIL MOISTURE, EVAPOTRANSPIRATION AND DEEP PERCOLATION IN AGRICULTURAL WATERSHEDS,
Nebraska Univ., Lincoln.
M. Arbab.
PhD Thesis, December, 1980. 222 p, 51 Fig, 12 Tab, 93 Ref, 5 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-11673.

Descriptors: *Model studies, *Agricultural watersheds, Computer models, Groundwater recharge, Simulation analysis, *Percolation, *Soil water, *Evapotranspiration, Big Blue River basin, Nebraska.

The main objective of this study was to develop a set of mathematical relationships and formulate this into a digital computer model to simulate the surface hydrology of an agricultural watershed. The model was to be structured so that it could be applied to the irrigated or non-irrigated areas within any watershed with a minimum of modification and it was to be sufficiently flexible to be combined with a groundwater model to handle a case where the principal interest was either the surface water or groundwater. The model was to be tested by its application to continuous daily records from two weighing lysimeters for the surface hydrologic responses. It was also to be applied to an actual watershed where both surface water and groundwater factors are important and interdependent. The basin hydrology simulator de-

scribed in this study meets and satisfies these objectives. The developed model offers water resource managers a new tool for operational and management planning. One of the integral aspects was the history matching study of the Upper Big Blue River Basin in Nebraska. General conclusions drawn from the results of the application of the model to the Upper Big Blue River basin are: essentially all of the water percolating below the crop root zone in the area contributes to the groundwater system and can be considered as groundwater recharge; and the natural recharge to the groundwater mainly occurs under the irrigated lands and lands covered by native vegetations and pasture. In dry farmed areas, depletion of soil moisture from the crop root zone by evapotranspiration process provides sufficient storage for precipitation and consequently very little or no percolation occurs. (Sinha-OEIS)
W82-03513

GENERALIZED STORAGE-YIELD RELATIONSHIPS FOR SURFACE WATER RESERVOIRS ON NORTHEASTERN UNITED STATES' WATERSHEDS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-03523

CALIBRATING AND VERIFYING THE SSARR MODEL--MISSOURI RIVER WATERSHEDS STUDY,
Utah State Univ., Logan. Coll. of Natural Resources.
T. W. Cunday, and K. N. Brooks.
Water Resources Bulletin, Vol 17, No 5, p 775-782, October, 1981. 4 Fig, 5 Tab, 14 Ref.

Descriptors: *Streamflow forecasting, *Runoff, Model studies, Calibrations, Model studies, *Hydrologic models, Streamflow Synthesis and Reservoir Regulation model, *Missouri River basin, Madison River, Gallatin River, Snowmelt, Watersheds, Reservoir operation.

The Streamflow Synthesis and Reservoir Regulation model (SSARR, U.S. Army Corps of Engineers, 1972) was calibrated and verified on two upper Missouri River watersheds, the Madison and the Gallatin. Model calibration was expedited by a procedure which used physical watershed characteristics and parameter sensitivity. Streamflow volumes from snowmelt were within 8% of observed volumes for both watersheds. Simulated volumes for verification years were within 15% in the Madison watershed and 12-28% in the Gallatin watershed. (Cassar-FRC)
W82-03549

DIVERGING OVERLAND FLOW,
Mississippi State Univ., Mississippi State. Dept. of Civil Engineering.
V. P. Singh, and N. Agiralioglu.
Advances in Water Resources, Vol 4, No 3, p 117-124, September, 1981. 7 Fig, 7 Ref.

Descriptors: *Mathematical models, *Overland flow, *Watersheds, *Rainfall-runoff relationships, *Kinematic wave theory, Hydrologic models, Mathematical equations, Rainfall, Spatial distribution, Model studies, Runoff, Hydrographs, Mathematical studies, Approximation methods, Mathematical analysis.

The diverging overland flow of a natural watershed was studied using kinematic wave theory approximations. The mathematical modeling of such a watershed has not been previously performed. The properties of some explicit analytical solutions derived in dimensionless form for constant lateral inflow were examined. These solutions gave good agreement with laboratory data reported in the literature for plane models. For time-variable rainfall, analytical solutions did not appear tractable. The present solutions may be extended, with only minor mathematical complexity, to include spatial variability of rainfall without changing the essential complexity, to include spatial variability of rainfall without changing the essential features. It was concluded that the kinematic wave approximation accurately describes diverging overland flow for most cases of hydrologic interest. (Geiger-FRC)
W82-03676

DAILY PARTITIONING OF RAINFALL TO SURFACE RUNOFF AND SOIL WATER ON COMPLEX LANDSCAPES,
Southern Piedmont Conservation Research Center, Watkinsville, GA.
A. W. Thomas, R. R. Bruce, and W. M. Snyder.
Transactions of the ASAE, VOL 24, No 5, p 1191-1198, September-October, 1981. 9 Fig, 4 Tab, 16 Ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, Precipitation, Rainfall, Storms, Runoff, *Soil water, Infiltration, Seasonal variation, Watersheds, Climates, *Soil-water-plant relationships.

An approach was sought to incorporate complexities of soils, plants, and climate in order to partition rainfall satisfactorily for some problems. Specific objectives were to mathematically partition rainfall into runoff and soil water in a heterogeneous landscape and to assess the results by comparison with measurements of runoff and soil water over three years. A segment of the landscape in the upper plain of the Southern Piedmont physiographic region was selected for study. The primary surface and subsurface features contribute to the hydrology of the landscape in this area. To maintain a constant soil surface, soil erosion and sedimentation in the study area were minimized by a uniform, dense grass cover. Considerable variation in water partitioning and retention was expected over the area, due in part to past erosion patterns. A single partitioning device was used to predict both runoff and soil water, thus imposing integrity and consistency on the model. This device, known as the retention function, was driven by re-scaled pan evaporation between rain events. The model was used to simulate three years of measured surface runoff and soil-water data from the 1.3 ha watershed. The test period included above and below average rainfall years, wet and dry periods, judged in terms of the dual outputs and the pattern of simulated runoff and soil water rather than specific storms or short periods. Annual summaries and seasonal patterns of measured and predicted water quantities indicated that the model can partition rainfall into runoff and soil water. The model utilizing site characteristics of the heterogeneous land area computed dual outputs for a calendar year on the IBM 370/158+ in about 18 central processor unit seconds. (Baker-FRC)
W82-03681

SURFACE WATER AND GROUNDWATER INTERACTIONS IN A SURFICIAL AQUIFER IN NORTHWEST IOWA,
Iowa State Univ., Ames. Dept. of Civil Engineering.
H. Arfa.
PhD Thesis, 1980. 250 p, 36 Fig, 36 Tab, 123 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-19621.

Descriptors: Surface water, Surface runoff, Groundwater, *Mathematical models, Rainfall, *Groundwater recharge, Aquifers, Water requirements, *Surface-groundwater relations, *Iowa, Groundwater fluctuations, *Water level fluctuations.

The objective of this research is to evaluate a surficial aquifer and its interaction with surface runoff, with an objective of constructing a general mathematical model to respond to these interrelations. To evaluate the application of probabilistic laws to surficial groundwater fluctuations, a study of the sequential variation of rainfall in Northwest Iowa was conducted. Rainfall variations were defined, from dry-dry to wet-wet sequences. The interaction between surface water and surficial groundwater is a complicated phenomenon, and a strong tool is needed. The best tool for this situation, to be both practical and reliable, is the use of mathematical models. The basin selected for study is the Floyd River Basin, above Alton, which has the approximate geometry and dimensions of a unit model of interest. Full emphasis is put on recharge concepts of surficial groundwater in the basin, and the capability of the aquifer to withstand temporary mining or over-drafting to meet the beneficial water use requirements of the basin. The text of this dissertation includes the essential scientific theories and definitions, results obtained, and considers the practical laws of interactions with necessary discussion. (Sinha-OEIS)
W82-03718

2B. Precipitation

RAINFALL INTERSTATION CORRELATION FUNCTIONS. II. APPLICATION TO THREE STORM MODELS WITH THE PERCENTAGE OF DRY DAYS AS A NEW PARAMETER,
Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
P. T. Stol.
Journal of Hydrology, Vol 50, No 1-3, p 73-104, March, 1981. 7 Fig, 5 Tab, 16 Ref

Descriptors: *Correlation functions, *Rainfall, *Gaging stations, Rain gages, Network design, Mathematical studies, Storms, Precipitation, Model studies.

A method was previously published for deriving rainfall interstation correlation functions from storm models. However, this method was incomplete in that dry days had to be skipped. In the present paper, a general formula is derived which has been extended with a parameter to account for the percentage of dry days that may occur in an area. The interstation correlation is a function of the interstation distance. The length and width of the storm are the parameters in the correlation function. The gaged area and the storm passing area must be well defined in order to obtain homogeneity with respect to statistical parameters. The storm model is the starting point in the actual procedure for deriving interstation correlation functions. Storm models suggested in the literature include rectangular, exponential and triangular models. The current analytical procedure was applied to these. The general patterns for the three storm models are similar. The rectangular model has lower correlation coefficients, especially when the fraction of dry days is small. Negative correlation occurs when the storm width has a small value. In practice it is difficult to distinguish between the three storm types. For large storm width values the correlation functions for the triangular and exponential storms are the same. (Cassar-FRC)
W82-03422

RAINFALL INTERSTATION CORRELATION FUNCTIONS. I. AN ANALYTIC APPROACH,
Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
P. T. Stol.
Journal of Hydrology, Vol 50, No 1-3, p 45-71, March, 1981. 4 Fig, 5 Tab, 43 Ref.

Descriptors: *Correlation functions, *Rainfall, *Gaging stations, Rain gages, Network design, Mathematical studies, Storms, Precipitation, Model studies.

Correlations between rainfall amounts measured in gages at various interstation distances are analytically determined for a triangular storm model. Previously, functions describing the relationships between interstation correlation and interstation distance (known as correlation function) were determined empirically from the diagram of estimated correlation coefficients plotted against the corresponding interstation distances. Characteristics of storms and test areas are inserted as parameters. (Cassar-FRC)
W82-03467

COMPARISON OF RESULTS OBTAINED WITH THE VIDIAZ SPECTROPLUVIOMETER AND THE JOSS-WALDVOGEL RAINFALL DISDROMETER IN A 'RAIN OF A THUNDERY TYPE',

Institut et Observatoire de Physique, Clermont-Ferrand (France).
G. Donnadieu.
Journal of Applied Meteorology, Vol 19, No 5, p 593-597, May, 1980. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Rain, *Radar, *Distribution patterns, *Remote sensing, Velocity, Measuring instruments, Spectropluviometer, Disdrometer, Precipitation, Rainfall.

A photoelectric spectropluviometer VIDIAZ, which measures the diameter and fallspeed of each raindrop, was used to determine the mean values of the raindrop size distribution, rainfall rate, liquid water content, and radar reflectivity in thunderstorms. The results were compared with those obtained using a Joss-Waldvogel disdrometer, which gives the diameter by measurement of the force of the impacting drops on a sensor, assuming that they fall at the terminal velocities in still air obtained by Gunn and Kinzer. Fourteen measurements of 1 minute each were made in a rain of a thundery type. The fallspeeds of raindrops were found to be about 13 to 1 percent above the values of Gunn and Kinzer for raindrops with diameters measuring between 0.8 and 2.8 millimeters. This relatively small deviation produces a correction of 12 percent on the rainfall rate and of 17 percent for liquid water content and radar reflectivity for the Joss-Waldvogel disdrometer. Rainfall rate, liquid water content, and radar reflectivity were found to have a common range of values for the two instruments once these corrections for the disdrometer and a correction coming from raindrops unrecorded by the spectropluviometer were included and an allowance was made for the statistical errors resulting from the natural fluctuations of the rain. (Carroll-FRC)
W82-03707

2C. Snow, Ice, and Frost

PROTON MOBILITY IN ICE,
Interuniversitair Reactor Inst., Delft (Netherlands).
M. Kunst, and J. M. Warman.
Nature (London), Vol 288, No 5790, p 465-467, December 4, 1980. 1 Fig, 35 Ref.

Descriptors: *Protons, *Ice, Physicochemical properties, Deuterium, Heavy water, Conductivity, Microwaves.

The vertical mobility of protons in H2O ice, determined by nanosecond pulse radiolysis microwave conductivity, was 0.0064 sq cm per volt per sec. Mobility of deuterons in D2O ice was 0.0024 sq cm per volt per sec at -5 C. Decreasing the temperature to -30 C doubled the values, corresponding to a negative activation energy of 0.15 eV. The narrow-band polaron theory predicts a sharp changeover to a thermally activated hopping motion at higher temperatures, with an activation energy which decreases with increasing temperature. At high enough temperatures, a maximum in mobility is predicted. This theory describes the data, with the main charge interaction apparently involving the 200 per cm 0-0 lattice vibration. Over a period of a few hundred nanoseconds the proton conductivity signal decays to 10-20% of the initial value. Temporary complexing of protons with L defects results in effective drift mobilities of 0.0008 and 0.0002 sq cm per volt per sec for H3O+ in H2O and D3O+ in D2O, respectively at -5 C. (Cassar-FRC)
W82-03701

RECRYSTALLISATION AND ELECTRICAL BEHAVIOUR OF GLACIER ICE,
British Antarctic Survey, Cambridge (England).
J. M. Reynolds, and J. G. Paren.
Nature, Vol 283, No 5742, p 63-64, January 3, 1980. 26 Ref.

Descriptors: *Resistivity, *Electrical properties, *Glaciers, Ice, Antarctic, Polar regions, Crystallization.

Previous studies have indicated that the electrical resistivity of ice from temperate glaciers, which is essentially at its pressure melting point, is about 1000 times greater than that of ice from polar regions, which is well below its pressure melting point. Recent studies have sought an explanation for this marked diversity in resistivity. The polar nature of Antarctic ice has been established by georesistivity measurements made on the George VI Ice Shelf, despite its saturation by melt-water from surface melt lakes. Although previous studies have suggested that different impurity concentrations may be responsible for the extremes in resistivity between temperate ice and polar ice, evidence from this study indicates that impurity levels are similar, in spite of the leaching of contaminants by free water in temperate glaciers. Such leaching activity is absent in true polar glaciers. Resistivity appears to be affected only indirectly by free water. The electrical behavior of high density ice formed on a cold glacier by compaction was found to be very similar to that of ice formed by the percolation and refreezing of melt water, implying that the electrical behavior of ice is completely stabilized within a few years after the ice forms. It is suggested that the complete removal of melt water runoff and the extent of recrystallization which occur in response to stress in temperate glaciers, but which are reduced or absent in polar ice masses, may be responsible for the differences in the electrical behaviors of these two ice forms. (Carroll-FRC)
W82-03702

2D. Evaporation and Transpiration

SIMULATION OF SOIL MOISTURE, EVAPOTRANSPIRATION AND DEEP PERCOLATION IN AGRICULTURAL WATERSHEDS,
Nebraska Univ., Lincoln.
For primary bibliographic entry see Field 2A.
W82-03513

2E. Streamflow and Runoff

PARAMETRIC STUDY OF FLOOD WAVE PROPAGATION,
Indian Inst. of Science, Bangalore (India). Dept. of Civil Engineering.
K. Sridharan, and M. S. M. Kumar.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY9, p 1061-1076, September, 1981. 13 Fig, 14 Ref.

Descriptors: *Wave propagation, *Flood waves, *Channel flow, Kinematic waves, Subsidence, Open channel flow, Fluid mechanics, Hydraulics, Flow characteristics, Parametric hydrology, Discharge hydrographs, Froude number, Unsteady flow, Varied flow.

This paper presents a parametric study of flood wave propagation based on numerical solutions of the nondimensionalized unsteady flow equations. The properties of a sinusoidal flood wave in a prismatic channel were studied for uniform initial flow. The uniform flow Froude number, the wave parameters, and the channel shape parameters are varied over a wide range. Several conclusions were derived from this work. Significant subsidence occurs in prismatic open channels, particularly in the cases of narrow channels, smaller initial uniform flow Froude numbers, and inflow hydrographs with smaller wave duration. Lower initial uniform flow Froude numbers are associated with greater subsidence. Lower inflow wave amplitudes give slightly higher subsidence. Lower wave duration values produce significantly lower subsidence. Side slope does not significantly affect the rate of subsidence except in narrow channels. The nondimensional speed of the wave peak is independent of side slope, except in narrow channels. The width of the channel significantly affects subsidence, with the least effect in wide channels. Relative wave amplitude and relative discharge rise decrease exponentially with distance in the initial reaches. The speed of the wave peak and that of the corresponding kinematic wave agree. (Cassar-FRC)
W82-03425

CALIBRATING AND VERIFYING THE SSARR MODEL--MISSOURI RIVER WATERSHEDS STUDY,
Utah State Univ., Logan. Coll. of Natural Resources.
For primary bibliographic entry see Field 2A.
W82-03549

PROBABILISTIC MODEL OF LONG-TERM FLUCTUATIONS ON THE LEVEL OF AN OPEN LAKE,
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
For primary bibliographic entry see Field 2H.
W82-03572

FLOOD AREA MODELLING FROM AN ELEMENTARY DATA BASE,
Leeds Univ. (England). School of Geography.
A. McDonald, and D. Ledger.
Journal of Hydrology, Vol 53, No 1-2, p 85-94, September, 1981. 6 Fig, 9 Ref.

Descriptors: *Flood hydrographs, *Flood damage, Topography, *Model studies, *Nonstructural alternatives, Flood conrol, Floodproofing, Flood peak, Flood profiles, Flooding, Mathematical models, Mathematical studies, Projections, *Flood plain management.

A model for predicting flood area for ultimate use in estimating the long-term losses that are incurred due to flooding treats the floodplain as a storage area for flows in excess of the channel capacity. The flood path is considered to follow a sequence of field inundations determined by topography termed the flood series. The movement of overspills through the flood series and the flood hydrographs having peaks in excess of bankfull discharge are used to estimate the overspill volume. The model was applied to a floodplain area of the River Nith of Southwest Scotland. Model accuracy was 85% for predicting flood area for a 50-year return interval flood. The advantages of using field units as proposed in the present model over channel extension modelling are discussed. More research into the patterns of return flows is needed to examine the duration of standing water or the distribution of floodwater over time following the passage of a hydrograph peak. (Geiger-FRC)
W82-03581

HYDRAULIC EXPONENTS,
Illinoiss Univ. at Urbana-Champaign. Dept. of Civil and Hydrosystems Engineering.
V. T. Chow.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1489-1499, 1981. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Hydraulics, *Mathematical studies, Channels, Channel flow, *Open-channel flow, Flow, Flow discharge, *Flow profiles.

The significance of hydraulic exponents is in their application to the computation of flow profiles of a gradually varied flow in prismatic open channels, where their use will greatly simplify the otherwise complicated computation. This paper clarifies the mathematical derivation of the hydraulic exponents and their implication in application to the computation of flow profiles of gradually varied flow in a prismatic channel The relationships between these hydraulic exponents, which are assumed to depend only on the average flow depth, and those which are assumed to vary with the flow depth of a given range are also explained. The use of the hydraulic exponents in a flow-profile computation involves an approximation, which is to use the values of these exponents at the average depth of the range of flow depth under consideration. This approximation greatly simplifies the computation by direct integration and has been proven to produce reliable results for practical purposes. The use of these hydraulic exponents would involve the variation of these values within the range of flow under consideration and would not therefore be useful to achieve simplification in a flow-profile computation by the method of direct integration. (Baker-FRC)
W82-03669

SAFE-YIELD ESTIMATES OF A WATER SUPPLY RESERVOIR ON AN UNGAGED STREAM,
Pennsylvania State Univ., University Park.
J. R. Ousey, Jr.
PhD Thesis, March, 1980. 95 p, 6 Fig, 11 Tab, 38 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-15826.

Descriptors: *Streamflow, *Drainage areas, Yield, Safe yield, Water supply, *Reservoir capacity, Hypsometric analysis, Saturated soils, *Low flow, Piedmont terrain, *Streamflow forecasting, Reservoir releases.

This investigation tested the usefulness of two basin parameters in predicting the low-flow streamflow characteristics of drainage basins in the metamorphic Piedmont terrain of southeastern Pennsylvania. The characterization of the low-flow regime developed from basin parameters was used in assessing the safe-yield potential of a water supply reservoir on an ungaged stream where a time-series analysis of collected flow data was not possible. The parameters chosen were the hypsometric integral and the saturated-soil cover of the selected basins. Both are integrative aspects of the numerous influences arising from the primary controls of geology and climate on an eroding stream basin. The characteristics of a number of gaged stream basins which have all formed in the same general geologic and climatologic regime were regressed against the baseflow characteristics of those basins. The results indicate the usefulness of the saturated-soil cover but not the hypsometric integral in predicting the exceedance values within streams formed on similar geology and in the same general area. The water supply capacity of a reservoir was then assessed using the regression formula developed from gaged streams, and was found to be operating at a level consistent with the design estimate of safe-yield under climate conditions that can be considered as normal. (Sinha-OEIS)
W82-03716

2F. Groundwater

INADEQUACIES IN THE TECHNIQUE OF RESISTIVITY METHOD FOR LOCATION OF WATERWELL SITES IN HARD ROCK AREAS,
Center for Water Resources, Madras (India).
For primary bibliographic entry see Field 7B.
W82-03412

ENVIRONMENTAL ISOTOPES AS A TOOL IN HYDROGEOLOGICAL RESEARCH IN AN ARID BASIN,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). In for Desert Research.
A. Issar, and J. Gat.
Ground Water, Vol 19, No 5, p 490-494, September/October, 1981. 4 Fig, 1 Tab, 11 Ref.

Descriptors: *Isotope studies, *Groundwater recharge, Geohydrology, Recharge, Tracking techniques, Groundwater movement, Precipitation, Evaporation, Wadi Feiran, *Isopotic tracers, A-Tor, Infiltration, Chemical composition, Alluvial plains, Paleohydrology, Geologic fractures, Salinity, Arid lands, Deuterium, Tritium, *Israel.

Stable and radioactive isotopes (deuterium, tritium, 018, and C14) were studied in groundwaters of the Wadi Feiran basin, Israel. The isotopic character of the waters allowed classification into four distinct groups. This information, combined with chemical analyses, was used to characterize the groundwater flow in this region. In the upper part of the basin some of the precipitation and snowmelt penetrates the shallow fractures of the crystalline rocks and flows out immediately as small springs. The spring water maintains the isotopic character of the precipitation. The remainder of the water penetrates into deeper fractures, maintaining its deuterium and 018 ratios while part of the tritium decays. This water continues on a longer route, picking up salts and showing evaporation trends. In the middle part of the basin, water which reaches the riverbed is rich in tritium, shows slight evaporation, and is otherwise similar to precipitation in isotopic composition. In the lower part of the basin, groundwater flows into the alluvial plain at A-Tor. Some water mixes with paleowater and emerges as thermal springs. (Cassar-FRC)
W82-03415

INVERSE SOLUTIONS OF THE THEIS EQUATION DETERMINED WITH PROGRAMMABLE CALCULATORS. II. DETERMINATION OF AQUIFER HYDRAULIC CONSTANTS FROM NUMERICAL TEST DATA,
G. Grimestad.
Ground Water, Vol 19, No 4, p 387-391, July/August, 1981. 6 Tab, 7 Ref.

Descriptors: *Theis equation, *Computer programs, *Aquifers, Storage coefficient, Transmissivity, Mathematical equations, Groundwater movement.

In the second of two articles on calculator programs for inverse solution of the Theis equation, Newton's method is used to develop an iteration formula to determine transmissivity and storage coefficient values from a combined Theissian expression that incorporates the information from two independent aquifer test data point sets. The resulting algorithm is used in a polynomial-based program for Hewlett Packard HP 67/97 calculators which is designed to process data corresponding to the full practical range of well function arguments and to accept measurements from 1 or 2 observation wells or from entirely different tests of a given equation. The appendix contains program modifications for series well function calculations. Sample calculations are given. (Cassar-FRC)
W82-03481

THE ORIGIN AND EVOLUTION OF SALINE FORMATION WATER, LOWER CRETACEOUS CARBONATES, SOUTH-CENTRAL TEXAS, U.S.A.,
Texas Univ. at Austin. Dept. of Geological Sciences.
L. S. Land, and D. R. Prezbindowski.
Journal of Hydrology, Vol 54, No 1-3, p 51-74, December, 1981. 7 Fig, 2 Tab, 41 Ref.

Descriptors: *Sedimentary basins, *Model studies, *Brines, *Groundwater movement, Faults, Mineralization, Carbonates, *Sedimentary petrology, Groundwater, Saline water, Aquifers, Minerals, Petrology, Mineral water, Thermal springs, Formation water, Thermal water, Sodium, Calcium, Geohydrology, Chlorine, Geologic fractures, Saline formation water, Gulf of Mexico basin, Texas.

Chemical variation that exists in formation water from a dip section through Lower Cretaceous rock in south-central Texas was explained by an interactive water-rock diagenetic model. Major faults serve as pathways for the vertical movement of basinal brines from the Gulf of Mexico basin into the Lower Cretaceous section. As the brine moves updip out of the Gulf basin and encounters limestone along the Stuart City Reef Trend, galena precipitates in late fractures. As the Ca-rich brine continues its upfault rise, it becomes progressively diluted until it causes dedolomitization along back-reef facies. Although minor amounts of calcite spar are present, no precipitation of authigenic phases has been found. As the brine is diluted and cooled, it also gains in Mg as a result of progressive dedolomitization. The formation water discharges along faults as hot mineral water. (Geiger-FRC)
W82-03540

MINOR - ELEMENT DISTRIBUTION IN MINERAL AND THERMAL WATERS (REPARTITION DES ELEMENTS TRACES DANS LES EAUX THERMO-MINERALS),
Grenoble Univ. (France). Unite de Geologie et de Pharmacie.
J. Sarrot-Reynauld, J. Rochat, and J. Dazy.
Journal of Hydrology, Vol 54, No 1-3, p 33-50, December, 1981. 5 Fig, 1 Tab, 30 Ref. (English Summary).

Descriptors: *Groundwater, *Spring water, *Thermal water, *Mineral water, Petrology, *Geochemistry, *Trace elements, Water analysis, Anions, Cations, Geohydrology, Water properties, Chemical properties, Minerals, Geologic formations, Groundwater recharge, Mineral springs, Mineralization, Sedimentary rocks, Metamorphic rocks, Granites.

Research on spring waters in Southern France and Iran was applied to the study of the origin and mineralization of thermal waters. Characteristic ratios between major and minor water constituents as well as the behavior of trace elements such as B, F, Br, I, Sr, Rb and Li allow distinctions to be made among thermal and mineral waters associated with granitic, metamorphic, or volcanic rocks or with sedimentary evaporates. The distribution of trace elements depends upon magmatic properties, wallrock chemical composition, the presence of large distended fractures and temperature. Eroded-rock types may be identified by the Br/I or Sr/Rb ion ratios of groundwater. Since the occurrence of Cl is relatively independent of the other halogens, this anion is thought to originate from a different source when it is present in mineral water. (Geiger-FRC)
W82-03541

GEOCHEMICAL AND ISOTOPIC CHARACTERISTICS OF SPRING AND GROUNDWATER IN THE STATE OF SAO PAULO, BRAZIL,
Sao Paulo Univ. (Brazil). Inst. de Geociencias.
M. Szikszay, J-M. Teissedre, U. Barner, and E. Matsui.
Journal of Hydrology, Vol 54, No 1-3, p 23-32, December, 1981. 4 Fig, 2 Tab, 5 Ref.

Descriptors: *Geohydrology, Groundwater recharge, *Spring water, *Aquifers, *Geochemistry, *Isotope studies, Physicochemical properties, Tectonics, Borehole geophysics, Groundwater, Water properties, Minerals, Chemical analysis, Water analysis, Chemical properties, Crystalline rocks, Aquifer systems, Geologic fractures, Petrology.

Spring water from Precambrian rock strips encompassing the coast of Sao Paulo was studied for relationships between lithology and the physicochemical properties of the water. Water from crystalline rock was classified as Ca-Mg-bicarbonate with low temperature and conductivity. Spring water arising from sediments and/or weathered crystalline rock contained Ca-Mg-chloride-sulfate. Na-bicarbonate water was associated with volcanic rock, diabase and basalt. Monthly isotopic analyses carried out on eight springs and rain water samples from the Aguas da Prata region indicated a local source of recharge. Chemical studies of the waters of the shallow Bauru and Basalto aquifers of the Parana Basin suggest recharge from the confined deep Botucatu-Piramboia aquifer through large fractures and faults. This hypothesis is strengthened by evidence of a tectonic disturbance within the anomaly zone of these aquifers. (Geiger-FRC)
W82-03542

TEMPORARY HYDROLOGIC CHANGES AFTER DEFORESTATION FOR PIONEER HOMESTEADING,
For primary bibliographic entry see Field 4C.
W82-03544

GROUNDWATER QUALITY IN VISAKHAPATNAM BASIN, INDIA,
Andhra Univ., Waltair (India). Dept. of Geophysics.
For primary bibliographic entry see Field 6D.
W82-03552

BOUNDARY INTEGRAL EQUATION SOLUTIONS TO MOVING INTERFACE BETWEEN TWO FLUIDS IN POROUS MEDIA,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
P. L-F. Liu, A. H-D. Cheng, J. A. Liggett, and J. H. Lee.
Water Resources Research, Vol 17, No 5, p 1445-1452, October, 1981. 11 Fig, 2 Tab, 16 Ref.

Descriptors: *Interfaces, *Porous media, Saline-freshwater interfaces, Upconing, *Coastal aquifers, *Saline water intrusion, Encroachment, Saline water, Seawater, Aquifers.

The position of the boundary between two immiscible fluids is accurately predicted after a period of time by use of the Dupuit-Forchheimer approximation. For intermediate and short times the use of the boundary integral equation method (BIEM) forms an accurate alternative. The location of a saltwater wedge under conditions of unsteady seaward flow of fresh water is difficult to predict with any technique, but the BIEM appears to do an adequate job. The expansion of this method to three dimensions would aid in the case of complex geometry. Such a program could be developed from the methods cited in this paper combined with those of Lennon. In the BIEM method the mixing between two fluids is assumed to be insignificant, with a sharp interface existing between them. Numerical and experimental results are presented for the tilting of a vertical interface in a Hele-Shaw cell. During the initial stage of the interfacial movement, nonlinear effects are clearly demonstrated. (Baker-FRC)
W82-03577

PATTERNS OF GROUNDWATER SALINITY CHANGES IN A DEEP CONTINENTAL-OCEANIC TRANSECT OFF THE SOUTHEASTERN ATLANTIC COAST OF THE U.S.A.,
Scripps Institution of Oceanography, La Jolla, CA.
F. T. Manheim, and C. K. Paull.
Journal of Hydrology, Vol 54, No 1-3, p 95-105, December, 1981. 3 Fig, 1 Tab, 28 Ref.

Descriptors: *Groundwater pollution, *Brines, Boreholes, Subsurface water, Geohydrology, Sodium chloride, Petrology, *Waste disposal, Subsurface mapping, Saline water, Permeability, Dissolved solids, Sedimentary basins, Chemical properties, Salinity, *Saline water intrusion, *Coastal aquifers, *Georgia coast.

Increased interest in using subsurface strata as waste disposal sites, in problems involving seawater encroachment, and in extension of the concept of 'freshwater resources' to water containing as much as 10 grams/kilogram total dissolved solids has increased interest in the composition and distribution of saline fluids in sedimentary strata. Studies of formation-fluid salinities in a transect from western Georgia to the edge of the Blake Plateau off the Georgia coast reveal similar offshore and onshore hydrochemical properties. A wedge of fresh-brackish groundwater is located about 900 m below the shelf, while on the land, brackish waters extend to a maximum depth of 1,200 m below sea level. In deeper horizons, brines with salinities greater than 100 grams/kilogram are found in what is thought to be Cretaceous strata that are anhydritic in the offshore area. Evaporitic deposits are also found at drill sites beneath the Blake Plateau, as evidenced by strong salinity gradients in interstitial waters. (Geiger-FRC)
W82-03582

CHARACTER OF BRINES FROM THE BELLE ISLE AND WEEKS ISLAND SALT MINES, LOUISIANA, U.S.A.,
Louisiana State Univ., Baton Rouge. Inst. of Environmental Studies.
M. B. Kumar, and J. D. Martinez.
Journal of Hydrology, Vol 54, No 1-3, p 107-140, December, 1981. 20 Fig, 23 Ref.

Descriptors: Geohydrology, *Brines, Water analysis, *Mine drainage, Minerals, *Chemical analysis, *Isotope studies, *Groundwater, Sodium, Calcium, Trace elements, Chemical properties, Salinity, Saline water, Ions, Anions, Cations, Salt mine, Belle Isle, Weeks Island, *Louisiana.

Chemical analyses of 110 samples of brines collected from active leaks, puddles, stalagmites and stalactites from the Belle Isle and Weeks Island salt mines were conducted and compared with the ionic compositions of average seawater, seawater concentrated by evaporation, and oil-field brine formation waters. Salt mine brines were mostly Na-Ca-Cl brine with minor amounts of ionic species, especially K, Br, B, and Sr. The mine brines resembled formation waters in their ionic distributions but showed higher levels of K and Br, suggesting some genetic relationship to a residual brine. The high concentration of Ca in the water, however, was highly indicative of formation water, and an admixture of a Ca-rich formation water with a K-Br-rich residual brine was hypothesized. Isotopic studies tend to support the theory that the salt mine brines arise from a formation water with unusually high levels of Ca, K and Br. (Geiger-FRC)
W82-03584

DISSOLUTION OF SALT ON THE EAST FLANK OF THE PERMIAN BASIN IN THE SOUTHWESTERN U.S.A.,
Geological Survey, Norman, OK.
K. S. Johnson.
Journal of Hydrology, Vol 54, No 1-3, p 75-93, December, 1981. 8 Fig, 1 Tab, 22 Ref.

Descriptors: *Geohydrology, *Brine, *Groundwater movement, *Sodium chloride, *Saline water, Groundwater, Aquifers, Permeability, Percolation, Minerals, Groundwater recharge, Petrology, Spring water, Hydrostatic level, *Permian Basin, Southwestern United States, Dissolved solids.

Hydrogeologic surveys of the Permian Basin of the southwestern United States show that natural dissolution of bedded salt occurs at shallow depths in many parts of this basin, especially on the Cimarron River, Elm Fork, and the Red River. In order for a salt deposit to dissolve, a supply of water unsaturated with respect to NaCl, an outlet for removal of brine, and energy to cause water to flow through the system are required. Salt is dissolved by groundwater at depths of 10 to 250 m, and the resulting brine moves laterally and upward under hydrostatic pressure through caverns, fractures and aquifers to form salt plains and salt springs on the surface. Groundwater in the Permian Basin is recharged through permeable rocks, alluvium, terrace deposits, karstic features and fractures. The dissolution of salt causes a self-perpetuating cycle in some areas. Cavern development caused by salt dissolution is followed by collapse and subsidence of overlying rock, allowing greater vertical permeability and increased water percolation and additional salt dissolution. (Geiger-FRC)
W82-03586

SEEPAGE FLOW IN EXTREMELY THIN AQUIFERS,
Bochum Univ. (Germany, F.R.). Inst. fuer Konstruktiven Ingenierbau.
G. Schmid.
Advances in Water Resources, Vol 4, No 3, p 134-136, September, 1981. 3 Fig, 2 Ref.

Descriptors: *Groundwater movement, *Solute transport, Model studies, Mathematical studies, Seepage, *Nitrates, Path of pollutants, Flow velocity, Aquifer characteristics, *West Germany.

A groundwater flow model, considering only a vertical cross-section of a thin aquifer, was used to simplify an investigation of the source of 130 ppm nitrate levels at a water-works in West Germany. The stream function approach to describing seepage flow was useful, since the velocity field and flow path were of primary interest. Although the aquifer was only 9 mm thick and 2 km in a horizontal direction, the stream function produced the desired flow field. The potential approach gave a one-dimensional solution, neglecting the vertical components. (Cassar-FRC)
W82-03594

NATURAL TEMPORAL VARIATIONS IN THE CHEMISTRY OF SHALLOW GROUNDWATER, ATHABASCA OIL SANDS AREA, ALBERTA,
Stanley Associates Engineering Ltd., Edmonton (Alberta),
For primary bibliographic entry see Field 2K.
W82-03611

THE ORIGIN AND ISOTOPIC COMPOSITION OF DISSOLVED SULFIDE IN GROUNDWATER FROM CARBONATE AQUIFERS IN FLORIDA AND TEXAS,
Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 2K.
W82-03644

ESTIMATING AQUIFER PARAMETERS FOR LARGE-DIAMETER WELLS,
Birmingham Univ. (England). Dept. of Civil Engineering.
K. R. Rushton, and S. M. Holt.
Ground Water, Vol 19, No 5, p 505-509, September/October, 1981. 4 Fig, 10 Ref.

Descriptors: *Well hydraulics, *Aquifer characteristics, *Model studies, Transmissivity, Pumping tests, Permeability, Confined aquifers, Unconfined aquifers, Shallow wells, India, Drawdown, Storage coefficient, Permeability.

Aquifer parameters were determined from pumping tests in large diameter wells by two methods--the curve matching technique based on analytical solutions and a numerical model. Both methods gave similar results under confined aquifer conditions. However, the curve matching technique was not reliable for use in unconfined aquifers where there is a significant decrease in saturated depth. In a confined aquifer test water was pumped at 691 cu m per day for 135 min from a well with a 2.4 m radius. Transmissivity was calculated at 24-29 sq m per day; storage coefficient, 0.0006 to 0.001; and effective radius, 2.3 m. The unconfined aquifer test used a well with 3.5 m radius and 10.73 m deep. Abstraction rate fell from an initial 1539 cu per day to 930 cu per day over 4 hours. Drawdown was 1.77 m. According to the numerical model, permeability was 105 m per day; storage coefficient, 0.007. The curve matching method gave unrealistic results: permeability of 68 m per day and storage coefficient of 0.0001. (Cassar-FRC)
W82-03647

ANALYSIS OF GROUND-WATER HYDROGRAPHS FOR DEFINING A CRYSTALLINE HYDROGEOLOGICAL ENVIRONMENT,
Osmania Univ., Hyderabad (India). Centre of Exploration Geophysics.
B. H. Briz-Kishore, and V. L. S. Bhimasankaram.
Ground Water, Vol 19, No 5, p 476-481, September/October, 1981. 8 Fig, 2 Tab, 4 Ref.

Descriptors: *Groundwater, *Geohydrology, Precipitation, Rainfall, Groundwater recharge, Geology, Topography, Terrain analysis, Water wells, Water level, Hydrographs, *India, Shadnogar Basin.

Analysis was made of water levels in wells in a typical weathered and fractured granitic environment of Shadnagar Basin, Andhra Pradesh, India. Each well was 15.24 cm in diameter and ranged in depth from 24 to 60 m bgl (below ground level). It was noted that the level at which water was encountered during drilling was always lower than the stabilized water levels. The level of water striking varied from 5.25 to 21.25 meters. Similarly the static water levels in the wells varied from 0.75 to 16.38 meters, which is higher than the water striking levels in the wells. The rise of water levels to the stabilized levels clearly indicates the pressure heads of the granitic aquifer and reveals the semiconfined nature of the system. Topography had no definite control over the water striking levels, but in the upland areas the water levels are deeper, with relatively low pressure heads as compared to the low-lying areas. Water levels for all the piezometer tubes in different nests were manually recorded at monthly intervals over a period of five years. Data indicate that there is a good hydraulic continuity between ground water in shallow weathered mantle and deep seated fractured zones. The influence of rainfall on the ground water system was also investigated. It was concluded that rainfall on the ground water system was also investigated. It was concluded that rainfall was the main source of recharge, and that there are no substrate inputs to the ground water system in the basin. (Baker-FRC)
W82-03648

STORAGE AND RETRIEVAL OF GROUNDWATER DATA AT THE U.S. GEOLOGICAL SURVEY,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 10B.
W82-03649

ISOTOPE HYDROLOGY OF GROUNDWATERS IN THE PAMPA DEL TAMARUGAL, CHILE,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
P. Fritz, O. Suzuki, C. Silva, and E. Salati.
Journal of Hydrology, Vol 53, No 1-2, p 161-184, September, 1981. 1 Fig, 4 Tab, 14 Ref.

Descriptors: *Isotope studies, *Groundwater dating, *Surface-groundwater relations, *Groundwater recharge, Isotopic tracers, Groundwater depletion, Altitude, Geohydrology, Groundwater level, Boreholes, Meteoric water, Groundwater availability, Spring water, Surface runoff, Semiarid climates, *Chile.

The semi-arid regions of Northern Chile have limited potential for water resources development. The isotope hydrology of the groundwaters of the arid Pampa del Tamarugal was studied to identify present-day groundwater recharge areas. Background studies on precipitation in the high Andes and spring- and surface-water investigations identified a well-defined meteoric water line. Altitude effects which were dependent on air-mass movements could not be defined without a more extensive sampling program. Maximum altitudes of recharge were assignable to springs in the Andes and at the eastern border of the Pampa del Tamarugal which originated from infiltrating surface waters. Certain groundwater systems were traced to specific river valleys, but most of the pumped groundwaters are fossil and their supply is diminishing. Limited subsurface recharge activity was found at the foot of the Andes, but this does not seem to keep up with groundwater depletion in this area. (Geiger-FRC)
W82-03651

HYDROLOGY AND MINING IN THE TUCSON AREAS,
Harshbarger and Associates, Tucson, AZ.
J. W. Harshbarger, and D. R. Hargis.
Mining Engineering, Vol 33, No 11, p 1611-1616, November, 1981. 5 Fig, 9 Ref.

Descriptors: *Groundwater basins, *Water management, Hydrology, Water demand, Water supply, *Arizona, Water supply development, Groundwater mining, Water reuse, Wastewater irrigation, *Tucson area.

The importance of groundwater supplies in the Upper Santa Cruz Valley is extreme. Metropolitan Tucson, surrounding agricultural areas, and the mineral industry are completely dependent on groundwater. Agriculture has been the largest user. Mountains bordering the Tucson Basin are composed predominantly of metamorphic and igneous intrusive rocks. The Tucson Basin comprises a structural depression formed by block faulting. The major fault system occurs along the base of the mountains. Principal surface drainage in the Tucson use area is the Santa Cruz River. In the past, pumpage of groundwater for agricultural use has been the major factor in the decline of basin water levels. As municipal and industrial pumpage in the area increases, a continuing decline in the water level can be expected. Irrigation use probably will not increase significantly, but utilization of effluent from the Tucson sewage treatment facility for agricultural irrigation in the future may decrease the volume of agricultural ground water pumpage. Groundwater law in Arizona developed prior to the accumulation of a body of significant scientific knowledge concerning groundwater occurrence and movement. Much work is needed in this area. (Baker-FRC)
W82-03697

THE ROLE OF PORE PRESSURE IN DEFORMATION IN GEOLOGIC PROCESSES,
T. N. Narasimhan, W. N. Houston, and A. M. Nur.
Geology, Vol 8, No 7, p 349-351, July, 1980.

Descriptors: *Pore pressure, *Deformation, *Hydraulic fracturing, Aquifers, Groundwater movement, Reservoirs, Seismology, Stress, Fluid mechanics, Geothermal studies, Geohydrology, Pressure head, Subsidence, Porous media.

Hydraulic fracturing and seismicity vs. pore pressure were among the areas of discussion at an interdisciplinary Penrose Conference on pore pressure and deformation sponsored by the Geological Society of America, November 9-13, 1979. This subject is important in many fields, for example, development of water resources and geothermal resources. One of the questions discussed was the maximum depth of groundwater circulation, believed to persist down to 20 km. Studies on stress-strain behavior of fluid-saturated rocks suggest that in some rocks (Cosco granite) the bulk modulus is sensitive to saturation, but in others (Solenhofen limestone) it may not be. Reservoir-induced seismicity research is being actively pursued. It is probable that migration of pore pressure transients is critical to induced seismicity. Hydraulic fracturing is used to measure stress in situ and to augment production of water, geothermal fluids, and oil. Fundamental studies on this subject included the nature and disposition of hydraulic fractures, conditions of stable and unstable fracture growth, growth of long elliptical cracks, and the role of the rate of fluid pressurization in controlling fracture disposition. Rapid pressurization tends to produce vertical fractures; slow pressurization, horizontal fractures. The following mechanisms, including some chemical effects, can contribute to abnormally high pore pressures: aquifer head due to natural recharge, fossil head due to exhumationor erosion, tectonic compression, rapid loading and compaction, influx of juvenile water, gas infiltration, phase changes in minerals or hydrocarbons, temperature changes, and osmotic phenomena. (Cassar-FRC)
W82-03706

SURFACE WATER AND GROUNDWATER INTERACTIONS IN A SURFICIAL AQUIFER IN NORTHWEST IOWA,
Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-03718

2G. Water In Soils

RELATION BETWEEN PHC AND SODIUM ADSORPTION RATIO (SAR) AND AN ALTERNATIVE METHOD OF ESTIMATING SAR OF SOIL OR DRAINAGE WATERS,
Science and Education Administration, Riverside, CA. Salinity Lab.
D. L. Suarez.
Soil Science Society of America Journal, Vol 45, No 3, p 469-475, May/June, 1981. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Saline water, *Irrigation effects, *Saline soils, Water analysis, Estimating equations, Mathematical studies, Irrigation, Water quality, Soil environment, Soil contamination, Hydrogen ion concentrations, Sodium, Sodium adsorption ratio.

An equation was derived which demonstrates the inter-relationships between the sodium adsorption ratio (SAR) of drainage water, irrigation water composition, pH, and the leaching fraction. SAR is used to predict the exchangeable sodium percentage of a soil. The accuracy of the new equations was evaluated by comparing the predicted SAR for drainage water of different water types and leaching fractions against computer model predictions. This method was found to predict SAR better than existing empirical equations. Satisfactory results can be obtained with rough estimates of P of CO2, as SAR is not very sensitive to this variable. SAR is also not particularly sensitive to the concentration of Ca under saline conditions and with Mg/Ca ratios greater than 1. Thus, a fair prediction of Ca can result in a good SAR prediction. If soil water SAR is being calculated, SAR surface can be estimated from the irrigation water SAR, or if groundwater is important, some corrections must be made for degassing and CaCO3 precipitation. (Small-FRC)
W82-03445

MASS TRANSFORT. 3. ROLE OF HYDRAULIC CONDUCTIVITY DATA IN PREDICTION,
British Columbia Univ., Vancouver. Dept. of Geological Sciences.
L. Smith, and F. W. Schwartz.
Water Resources Research, Vol 17, No 5, p 1463-1479, October, 1981. 14 Fig, 6 Tab, 13 Ref.

Descriptors: Conductivity, *Model studies, Stochastic process, Mathematical studies, *Mass transfer, Prediction, Stochastic hydrology, Forecasting, *Solute transport, *Hydraulic conductivity.

A stochastic analysis of mass transport has been carried out to investigate various relationships between the number of hydraulic conductivity measurements available to characterize the heterogeneity and the resulting uncertainty in transport predictions. Uncertainties arise both from the unknown spatial variation in hydraulic conductivity and in estimating the parameters of the probability distribution for hydraulic conductivity. Simulations were based on limited sampling of hydraulic conductivity values from a series of hypothetical field sites. Results were interpreted, keeping in mind the uncertainty in determining seepage velocities within the flow system. For the sample grids considered, the mean arrival times obtained in the stochastic simulation can differ significantly from arrival times calculated for the hypothetical section representing the field setting. Measurements of hydraulic conductivity did not lead to large reductions in the uncertainty in the velocity field, as the hydraulic gradient itself was a random variable. Results of the study suggest that given a moderate number of data points, the unknown patterns of spatial variation in hydraulic conductivity were a more important source of uncertainty than errors in estimating the mean and standard deviation of the hydraulic conductivity distribution. (Baker-FRC)
W82-03578

APPLICATION OF SOIL WATER FLOW THEORY IN FIELD SIMULATION,
Technical Univ. of Denmark, Copenhagen.
K. H. Jensen.
Nordic Hydrology, Vol 12, No 3, p 167-184, 1981. 12 Fig, 1 Tab, 9 Ref.

Descriptors: *Soil-water-plant relationships, *Evapotranspiration, *Irrigation practices, Soil moisture, *Model studies, Capillarity, Infiltration, Interception, *Soil water, Evaporation, Grasses, Barley, Soil water movement.

A soil moisture model based on the basic differential equation for soil water flow is developed. It includes terms for interception, transpiration, soil evaporation, and soil water flow. Empirical relationships from the literature are used where mathematical descriptions are unavailable. Input data to the model are hourly precipitation and meteorological data, irrigation treatment, leaf area index, root zone depth, root extraction pattern, and water table fluctuations. Required model parameters are moisture content-capillary pressure relationships and hydraulic conductivity-capillary pressure relationships for each soil layer. Outputs are simulated time variation in soil moisture content, capillary pressure, and soil water flow at different levels. The model results agreed fairly well with field observations on grass and barley plots in Denmark. (Cassar-FRC)
W82-03589

DAILY PARTITIONING OF RAINFALL TO SURFACE RUNOFF AND SOIL WATER ON COMPLEX LANDSCAPES,
Southern Piedmont Conservation Research Center, Watkinsville, GA.
For primary bibliographic entry see Field 2A.
W82-03681

AIRBORNE SOIL MOISTURE MEASUREMENT USING NATURAL TERRESTRIAL GAMMA RADIATION,
National Weather Service, Minneapolis, MN. North Central River Forecast Center.
T. R. Carroll.
Soil Science, Vol 132, No 5, p 358-366, November, 1981. 3 Fig, 2 Tab, 22 Ref.

Descriptors: *Remote sensing, *Soil water, Measuring instruments, *Gamma radiation, Radiation, Water availability, Moisture availability, Moisture stress, Drought, Moisture deficiency.

Airborne gamma radiation flux data were collected over a network of 240 flight lines in the upper Midwest. Each flight line was approximately 6 square kilometers. The data were used to calculate real-time, areal soil moisture values. The gamma radiation attenuation technique was able to measure the soil moisture flux in the upper 20 cm of the soil surface with sufficient accuracy for operational applications. A comparison with soil moisture data collected from a network of 240 flight lines in the upper Midwest indicates that mean areal soil moisture values can be calculated with an RMS error of 3.2% soil moisture. Airborne soil moisture values tended to be 1.5% less than the ground sampled values. The airborne gamma radiation technique was able to measure reliable, real-time mean, areal soil moisture values over large areas with the accuracy required for operational hydrologic and agricultural applications. An operational soil moisture survey program could make real-time data available to users interested in soil moisture conditions in the fall prior to snow accumulation, in the spring to assess surface conditions prior to crop planting, or at any time to quantify extremely wet or dry soil moisture conditions over large areas. (Baker-FRC)
W82-03685

NONLINEAR SORPTION OF WATER IN SOIL,
Vanderbilt Univ., Nashville, TN.
A. D. Koussis.
Soil Science, Vol 132, No 4, p 262-266, October, 1981. 3 Tab, 14 Ref.

Descriptors: *Soil water, *Model studies, Mathematical studies, Sorption.

The accuracy of an approximate analytical solution, based on integral requirements, for nonlinear sorption of water in soil has been studied. An earlier solution proposed by Brutsaert has been obtained as a special case through a particular parameter choice. Comparisons with exact solutions have been carried out for power law soil. Results bear out the expectation that Brutsaert's approach will be simple and accurate over a wide range of diffusivities, from weakly variable to strongly variable. Although the accuracy of Brutsaert's solution is not as high as that of the general integral-approximation solution, its performance is more than adequate for practical purposes and proves it a versatile and flexible tool. Also, suggestions regarding the improvement of the computational efficiency of iterative numerical integration of the one-dimensional diffusion equation are made, which are based on available close estimates for the sorptivity. (Baker-FRC)
W82-03686

DEVELOPMENT OF A SOIL MOISTURE MODEL FOR USE WITH PASSIVE MICROWAVE REMOTE SENSORS,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
W. C. Bausch.
PhD Thesis, May, 1980. 187 p, 82 Fig, 10 Tab, 55 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-23014.

Descriptors: *Soil water, *Model studies, *Mathematical models, Soil profiles, *Remote sensing, Prediction, Moisture content, Passive microwave sensors.

Soil moisture profiles were simulated for a hypothetical loam-like soil with a water and heat balance model. Expected X-band and L-band radiometer response to these conditions as simulated by a radiative transfer model. From these simulations, a model was developed to estimate soil water content in two layers of a 1.5 m soil profile. Soil water content in the top 21 cm of the hypothetical soil was related to L-band emissivity over a wide range of soil moisture conditions. Inverted soil moisture profiles which result from small rains were classified by use of the rate of change in L-band emissivity one day after the rain. The amount of water added to the soil profile below the 21 cm depth due to percolation was related to a ratio of the rate of change in X-band and L-band emissivities one day after the rain. These relationships were combined into a comprehensive model that predicts soil moisture in two zones of the soil profile. This model was tested with measurements of soil water content and soil temperature collected during the four seasons of the year in a sandy loam soil contained in an array of lysimeters. X-band and L-band emissivities required in the predictor equations were calculated by the radiative transfer model from measured soil moisture and soil temperature data. The technique developed from simulated results to classify inverted soil moisture profiles was found to be seasonally dependent. It was also found that the second layer algorithm showed seasonal dependence. (Sinha-OEIS)
W82-03715

AERATION STATUS OF A STRATIFIED SOIL WITH A FALLING WATER TABLE,
Utah State Univ., Logan.
M. Z. Ahmadi.
PhD Thesis, 1980. 167 p, 37 Fig, 29 Tab, 72 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-19230.

Descriptors: *Soil aeration, *Model studies, *Water table, Mathematical models, Equations, Aeration, Soil water, Moisture content, Oxygen, Soil types, Stratified soils, Soil water pressure.

Two Richards type equations were used to define soil aeration status, one for soil water pressure and one for oxygen concentration. A third equation related the soil water pressure (volumetric water content) with oxygen concentration and oxygen diffusion rate for a one-dimensional vertical stratified soil column. The equations were solved using Brooks-Corey's functional relationship between soil water pressure and volumetric water content, the Crank-Nicolson method of differencing, general Newton method, successive overrelaxation. The numerical model considers uniform and two-layered soils; plants and no plant; and saturated and unsaturated conditions for a falling water table. The model predicts soil water pressure, volumetric water content and oxygen diffusion rate throughout the column at any time step following an initial static water table location. The no-plant numerical model was tested against laboratory data. Except for the oxygen diffusion rates near the soil surface which are not reliable due to malfunctioning of oxygen diffusion rate meter, the no-plant model, in general agrees with the laboratory data. (Sinha-OEIS)
W82-03717

MOISTURE MOVEMENT IN SOILS IN THE VICINITY OF WASTE DISPOSAL SITES,
Texas Univ. at Austin.
D. E. Daniel, Jr.
PhD Thesis. December, 1980. 256 p, 81 Fig, 6 Tab, 117 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-09151.

Descriptors: *Soil water, *Computer programs, *Waste disposal, Soil properties, Hydraulics, Soil water suction, Saturation, Hydraulic conductivity, *Unsaturated flow, Solute transpot.

Four objectives to the research were: (1) to study methods of measuring the hydraulic properties of unsaturated soil over a broad range in degree of saturation; (2) to develop a computer program for analyzing the transient movement of water through saturated or unsaturated soil; (3) to measure rates of water movement in several unsaturated soils and to compare the measured rates to those predicted by the computer program; and (4) to analyze an example disposal facility in order to illustrate how the program might be used for practical problems. The main conclusions are: The most important hydraulic properties of unsaturated soil are the moisture characteristic curve (plot of degree of saturation versus suction) and the relationship between hydraulic coductivity and degree of saturation. The thermocouple psychromcter is the best device to use for measuring suctions over the range of about 1 to 80 atm. The instataneous profile method, with psychrometric suction probes, was found to be the best method available for measuring hydraulic conductivity of clays over a wide range in degree of saturation. The most useful features of the fnite clement program, which was written to calculate the time-dependent change in hydraulic head, and associated variables such as degree of saturation, were found to be the following: dynamic dimensioning, semi-automatic mesh generation, time-dependent or cyclic boundary conditions, automatic time step control, and the capability of tracing the time-dependent movement of water through the ground. Analysis of an example problem showed that the ability of the program to trace the time-dependent movement of water through the soil is the most useful feature of the program. (Sinha-OEIS)
W82-03728

2H. Lakes

PHOTOSYNTHETIC BACTERIAL PRODUCTION AND CARBON MINERALIZATION IN A MEROMICTIC LAKE,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Science.
T. B. Parkin, and T. D. Brock.
Archiv fur Hydrobiologie, Vol 91, No 3, p 366-382, June, 1981. 5 Fig, 2 Tab, 26 Ref.

Descriptors: *Carbon cycle, *Meromictic lakes, *Photosynthetic bacteria, Lakes, Bacteria, Primary productivity, Productivity, Sedimentation, Sulfur bacteria, Mineralization, Algae, Phytoplankton.

Primary production, sedimentation, and decomposition were measured in meromictic Knaack Lake, Wisconsin, throughout the annual cycle. During thermal stratification in spring, summer, and early autumn a dense population of photosynthetic sulfur bacteria was present at the oxygen-sulfide boundary. When the lake ice melted in April, bacterial chlorophyll d concentrations increased steadily to over 800 mg per sq m during the summer and decreased in October. Although green and blue-green algae were present in the epilimnion, chlorophyll a concentrations were low (20-90 mg per sq m) during summer. The photosynthetic sulfur bacteria composed 41-92% of the total phytoplankton standing crop on a chlorophyll basis and 8-58% on a carbon basis. However, they were responsible for only 3.3-5.6% of the total primary production in the lake. The algae of the epilimnion showed rapid turnover rates, whereas the green sulfur bacteria of the hypolimnion had slow turnover rates. (Cassar-FRC)
W82-03403

NUTRIENT RELATIONSHIPS IN SHALLOW WATER IN AN AFRICAN LAKE, LAKE NAIVASHA,
Nairobi Univ. (Kenya). Dept. of Botany.
J. J. Gaudet, and F. M. Muthuri.
Oecologia, Vol 49, No 1, p 109-118, 1981. 9 Fig, 3 Tab, 37 Ref.

Descriptors: *Cycling nutrients, *Lakes, Seasonal variations, *Africa, *Lake Naivasha, Littoral zone, Intertidal areas, Littoral environment, Interstitial water, Shallow water, *Nutrients, Phosphorus, Nitrogen, Sulfur.

Total nutrient levels of nitrogen, phosphorus, and sulfur were determined in a shallow water tropical community with emphasis directed toward the macrophyte, water and hydrosoil components. Nutrient release from macrophyte decomposition was studied, and general transfer patterns within this macrophyte-water-hydrosoil system were sought. The area under study was located at the edge of

Lake Naivasha, a closed-basin lake in East Africa. One long permanent transect was set out from land to the open lake, with five stations located along it. One sampling station was located in a zone dominated by Kikuyu grass, stations 2, 3, and 4 were in a sledge zone, and station 5 was in open water. The mean annual conductance and temperature decreased, while pH increased going out from shore as water depth increased. Total P was generally higher during drawdown (June-July), decreasing later in the year. The concentration of particulate P was greater than dissolved P. The ratio of the two forms of P differed from zone to zone. Total nitrogen concentrations were higher than either phosphorus or sulfur, with the highest mean annual concentration occurring in the sledge zone and the least concentration in the open water. Highest mean phosphorus and sulfur levels were generally found in the grass zone. Of the three nutrients, total sulfur was generally at the lowest overall concentration. The main source of plant nutrients in the drawn-down zone of Lake Naivasha would seem to be the interstitial water filling the space among the solid particles of the hydrosoil. (Baker-FRC)
W82-03404

GROWTH AND REPRODUCTION OF POTAMOGETON CRISPUS IN A SOUTH AFRICAN LAKE,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Botany.
K. H. Rogers, and C. M. Breen.
Journal of Ecology, Vol 68, No 2, p 561-571, July, 1980.

Descriptors: *Potamogeton, *Nutrients, *Aquatic plants, *South Africa, *Lakes, Nitrogen, Phosphorus, Plant physiology, Standing crops.

Potamogeton crispus L. plants are involved in the nutrient dynamics of their floodplain lake environment. They grow and take up nutrients from water and sediments from autumn to spring, at which time the vegetative parts decay and release nutrients to the water. Between September 8 and January 9 a mean of 2 mg per sq meter per day of phosphorus and 7 mg per sq meter per day of nitrate-N was released for uptake by other components of the system. During the summer, when P. crispus is dormant, the lakes in this South African floodplain are separated from their river source. If a flood were to occur at this time (an unlikely happening), nutrients would be washed out by the nutrient-poor flood water. (Cassar-FRC)
W82-03406

ALGAL SEDIMENTATION IN RELATION TO PHYTOPLANKTON PERIODICITY IN ROSTHERNE MERE,
Freshwater Biological Association, Ambleside (England).
D. Livingstone, and C. S. Reynolds.
British Phycological Journal, Vol 16, No 2, p 195-206, June, 1981. 9 Fig, 3 Tab, 19 Ref.

Descriptors: *Phytoplankton, *Sedimentation, *Seasonal variation, Algae, *Rostherne Mere, *England, Turbulent flow, Sediment traps, Lakes, Measuring instruments, Diatoms.

Seasonal variations in phytoplankton composition were studied in Rostherne Mere, England, using cylindrical sediment traps and quantitative measurements of standing crops. Trap catches generally reflected the plankton compositon during the preceding trapping period when operated in weakly turbulent waters. Turbulence, which is infrequent in this lake, exaggerated the fluxes. Diatoms were assessed as 2-20 times more numerous using the trap than standing crop estimates. Microcystis and Nitzschia catches were in good agreement with estimated areal fluxes. (Cassar-FRC)
W82-03414

THE PHYTOPLANKTON AND PROTOZOOPLANKTON OF THE EUPHOTIC ZONE OF LAKE TANGANYIKA: SPECIES COMPOSITION, BIOMASS, CHLOROPHYLL CONTENT, AND SPATIO-TEMPORAL DISTRIBUTION,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
R. E. Hecky, and H. J. Kling.
Limnology and Oceanography, Vol 26, No 3, p 548-564, May, 1981. 6 Fig, 6 Tab, 33 Ref.

Descriptors: *Lakes, *Phytoplankton, *Zooplankton, Seasonal variation, Population dynamics, Chlorophyll A, *Lake Tanganyika, *Africa, Biomass, Fish food organisms.

Phytoplankton and protozooplankton were surveyed at two widely separated pelagic stations in the euphotic zone of Lake Tanganyika (Africa) from February through November 1975, and three seasonal phases were determined. During stable stratification, biomass was minimal; it was maximal at the end of the deep mixing period. Diatoms were abundant only during mixing. Filamentous blue-greens were abundant when the lake experienced rapid surface warming, which produced shallow mixed layers following the period of deep mixing. Chlorophyll alspha ranged from 0.1 to 4.5 mg/cu m in the euphotic zone and from 0.2 to 20.4 in surface waters. Phytoplankton biomass ranged from 25 to 1570 mg/cu m in the euphotic zone. Annual means for both phytoplankton and chlorophyll alpha were very low and annual variability was high. This may be because of the lake's steep morphometry, which affects nutrient generation, and the high loss rates, which cause high algal growth rates but low algal masses. (Small-FRC)
W82-03419

PRIMARY PRODUCTION AND RATES OF ALGAL GROWTH IN LAKE TANGANYIKA,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
R. E. Hecky, and E. J. Fee.
Limnology and Oceanography, Vol 26, No 3, p 532-547, 1981. 3 Fig, 3 Tab, 47 Ref.

Descriptors: *Primary productivity, *Algal growth, *Eutrophic lakes, Aquatic productivity, Biomass, *Lake Tanganyika, *Africa, Fish.

Two surveys were conducted over pelagic regions of Lake Tanganyika (Africa) during minimum and maximum standing crop to determine primary production and rates of algal growth. The mean rate of integral primary production was 1.4 g C/sq m/day for cloudless weather. There was no consistent pattern of diurnal variation. The mean annual rate was estimated to be 1 g C/sq m/day. High algal growth rates of 0.1 to 3.0/day with a mean of 0.9 were estimated. There is a high fish population in the lake, which requires either very high trophic efficiency based on measured pelagic primary production or an additional source of energy derived from the anoxic deep water. It is suggested that the long geological history of the lake has allowed the evolution of a biological community consisting of highly efficient species. (Small-FRC)
W82-03420

A FACTOR ANALYSIS OF ELEMENTAL ASSOCIATIONS IN THE SURFACE MICROLAYER OF LAKE MICHIGAN AND ITS FLUVIAL INPUTS,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
J. E. Mackin, R. M. Owen, and P. A. Meyers.
Journal of Geophysical Research, Vol 85, No C3, p 1563-1569, March, 1981. 5 Fig, 3 Tab, 52 Ref.

Descriptors: *Water analysis, Lakes, *Rivers, *Lake Michigan, Chemical composition, Particulate matter, Calcium, Copper, Iron, Potassium, Manganese, Factor analysis, Metals, Free surfaces, Fluvial environment, Inflow, Water pollution sources.

The concentrations of Ca, Cu, Fe, K, Mn, and organic carbon in samples of the surface microlayer (125 + or - 5 micrometers) and 1 meter deep subsurface water samples from 10 locations in Lake Michigan and 10 of its river sources were subjected to separate R mode factor analyses. These revealed that the variance in the surface microlayer and subsurface river samples was governed by regional geology and the nature of weathering in individual drainage basins. In the particular phase, Ca, Fe, K, and Mn were higher in microlayer and subsurface river samples than in the lake samples because mineral grains settle out before entering the lake. Concentrations of materials in river subsurface waters are also affected by upward diffusion of sediment pore fluids and resuspension of bottom sediments. The variations in chemical composition of the lake samples were a result of physiochemical interactions such as complexation with organic matter (Fe, Cu), carbonate equilibria (Ca, Mn), precipitation of hydrous oxides (Fe, Mn, Cu), biological uptake (K), and bubble transport of very fine mineral particles to the surface. The bubble transport mechanism obscures the patterns of atmospheric fallout of Fe and Mn. (Cassar-FRC)
W82-03442

SIGNAL ANALYSIS OF IRRADIATION, TEMPERATURE AND PRIMARY PRODUCTION IN A SMALL ARTIFICIAL POND, II. THE RESIDUAL SPECTRA,
Amsterdam Univ. (Netherlands). Lab. of Aquatic Ecology.
R. Lingeman.
Internationale Revue der Gesamten Hydrobiologie, Vol 66, No 2, p 203-222, 1981. 6 Fig, 4 Tab, 14 Ref.

Descriptors: *Primary productivity, *Ponds, *Irradiation, Radiation, Temperature effects, Spectrophotometry, Spectral analysis, Dissolved oxygen, Ecosystems.

Methods and results are presented of an extensive spectral analysis applied to the residues of the two-year series of irradiation, temperature and gross production after elimination of the slow components in a small artificial pond. The spectral analysis procedure proposed and executed is for the residual signals of total diurnal irradiation, diel mean temperature and diurnal gross primary production. The residual power spectrum of diurnal irradiation was shown to be essentially that of a white noise. Several higher frequencies were significantly present in both the signals of temperature and production. Some consideration is given to the cross correlation between the latter two parameters. After the detection of possible frequency peaks in the power spectrum had been made, the significance of the periodic components of each signal was tested by least squares fitting to sinusoidal models. Both the spectrum of the temperature and the spectrum of production showed distinct peaks at 2,7, 14, and 21 cy. No peaks were traceable in the power spectrum of irradiation. In the temperature signal, the 2 and 7 cpy periodic components were significant. The production signal had components of 7 and 14 which were significant. The results of spectral estimation and successive model fitting strongly suggest the simultaneous appearance of idnetical frequencies in the residual time series of temperature and production. The synchronous small oscillations superimposed on the annual signals of temperature and primary production may point to a residual effect of temperature on the productive system. (Baker-FRC)
W82-03465

THE EFFECT OF ARTIFICIAL DESTRATIFICATION ON PHYSICO-CHEMICAL PARAMETERS AND PHYTOPLANKTON IN HAM'S LAKE, OKLAHOMA,
Oklahoma State Univ., Stillwater.
For primary bibliographic entry see Field 5G.
W82-03510

STRATIFICATION AND MIXING IN SHALLOW TROPICAL AFRICAN LAKES,
Duke Univ., Durham, NC. Dept. of Zoology.
S. MacIntyre.
PhD Thesis, 1981. 361 p, 77 Fig, 23 Tab, 134 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-19639.

Descriptors: *Lakes, *Stratification, *Chemical stratification, *Mixing, *Water circulation, Shallow water, Sedimentation, Primary productivity, Wind, *Kenya, Africa.

Circulation patterns within a lake have a direct impact on the lake's productivity and sedimentation rates and on the fate of pollutants injected into the lake. Shallow windswept African lakes stratify and mix on a daily basis and are noted for their exceptionally high rates of primary productivity. Measurements of current speeds and temperature profiles were used to characterize daily mixing events in three shallow African lakes of differing morphology and exposure to wind. Reasons for the persistence of chemical stratification were explored in a sheltered crater lake. During limnological investigations spanning the 1970's, chemical stratification was always observed in Lake Sonachi. This indicates that the lake is meromictic. Two factors that can contribute to the maintenance of meromixis are weak wind mixing and biological decomposition below the chemocline. Although Lake Sonachi is sheltered from wind by crater walls 30 to 100 m above the lake's surface, gusty winds were common. Freshening of the surface waters by rain contributed to the increased stability, but the conductivity and volume of water below the chemocline had also increased substantially. It is hypothesized that chemical stratification in Lake Sonachi is enhanced by groundwaters that dissolve evaporites in the lake sediments and seep into the lake. (Sinha-OEIS)
W82-03514

INVESTIGATION OF THE ACCURACY OF WATER LEVEL TRANSFER TO DETERMINE GEODETIC ELEVATION IN LAKE ONTARIO,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
H. W. Stoughton.
PhD Thesis, 1980. 336 p, 17 Fig, 37 Tab, 380 Ref, 12 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-17375.

Descriptors: *Water level, *Lakes, Mathematical studies, *Geodetic levelling, Lake levels, *Lake Ontario.

An investigation of the accuracy of using the mean surface of a large lake for geodetic levelling is reported. This investigation concentrated on Lake Ontario. The data collected for IFYGL provided adequate information to evaluate mean lake level over widely spaced gage sites. The investigations of lake level for both engineering and geological studies noted the influences of wind setup, variations in barometric pressure, storm runoff, precipitation, and gage location, but it was recognized that there was insufficient data to demonstrate their systematic effect on the mean lake level at a gage. The investigation evaluated the accuracy of geodetic levelling accomplished by the use of mean lake level gage readings for the 'water level transfer' of elevations across Lake Ontario. The employment of this technique requires an elevation system expressing differences in elevation in units of work. This investigation employed the equipotential system based on normal gravity (dynamic heights(because gravity had been observed only at bench marks along the United States portion of the level line. The comparisons of the four month mean difference in elevation as determined by the differences in the lake level gage readings compared to the difference in elevation determined by geodetic levelling were in close agreement. (Sinha-OEIS)
W82-03515

SPACE-TIME SCALES OF TEMPERATURE VARIABILITY IN THE SEASONAL THERMOCLINE OF LAKE TAHOE,
Oregon State Univ., Corvallis.
J. M. Brubaker.
PhD Thesis, June, 1980. 114 p, 31 Fig, 5 Tab, 39 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-05611.

Descriptors: *Lakes, *Thermocline, Thermal stratification, Seasonal variation, *Water temperature, Temperial distribution, Spatial distribution, *Lake Tahoe, Space-time scales.

The objectives of this work are to characterize and, when possible, to interpret temperature finestructure and microstructure observations made with vertical profiling instruments in the upper thermocline of Lake Tahoe during late summer stratification. From the finestructure data (observations with the TD instrument) the following characteristics of temperature variability in the Tahoe thermocline were found. Over time scales of days to weeks, or over horizontal scales of several km, relatively large amplitude temperature fluctuations were observed. In contrast, for sampling limited to 2 1/2 hours and to about 200 m horizontally, the ensemble variability was of smaller magnitude. Vertical wavenumber spectra of temperature fluctuations fell steeply. Results on scales of variability represent only a first step toward development of a full frequency-wavenumber spectrum for the temperature field, but should provide some perspective and organization structure for future work. Similarities of some features of the Tahoe spectra (and cross spectra) to oceanic results support the idea that similar dynamics control the small-scale structure in both environments. Thus, Tahoe could find extensive use as a 'laboratory' for studying some oceanic phenomena. (Sinha-OEIS)
W82-03519

ARSENIC IN LAKE LANSING, MICHIGAN,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 5B.
W82-03522

MOVEMENT OF COBALT IN FRESHWATER MICRO-ECOSYSTEMS,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
S. S. Tucker.
PhD Thesis, May, 1980. 167 p, 34 Fig, 7 Tab, 115 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-22598.

Descriptors: *Lakes, *Sediments, *Cobalt, *Ecosystems, Aquatic life, Mathematical analysis, Turnover time, Cobalt radioisotopes, *Microorganisms, Path of pollutants, Biotic components, Freshwater environment, Gammarus fasciatus, Nitzschia palea, Celtis occidentalis.

Radiocobalt was used to study the cobalt cycle in aquatic microcosms consisting of five possible compartments. All combinations of lake water, sand, amphipods (Gammarus fasciatus), microflora (Nitzschia palea), and detritus (leaves of Celtis occidentalis) were linked in two, three, four, and five compartment microcosms. The movement of cobalt between water and amphipod, microflora, and detritus compartments was characterized by a set of first order differential equations, while the movement between water and sand compartments was characterized by a partial differential equation due to the slow diffusion of cobalt into the underlying layers of the sand compartment. Cobalt movement in freshwater systems is significantly controlled by the sediment acting as a cobalt sink. Biotic components are capable of turning over cobalt and, in most cases, these turnover rates increase as the number of biotic components increases. Resistance of aquatic systems to perturbation and resilience after perturbation may be found to increase with complexity using certain indices; however, other stability indices show no correlation with system complexity using certain indices; however, other stability indices show no correlation with system complexity. This variable correlation between complexity and stability agrees with other recent ecosystems studies reported in the literature. (Sinha-OEIS)
W82-03524

WATER CHEMISTRY OF ALABAMA PONDS,
Auburn Univ., AL.
For primary bibliographic entry see Field 2K.
W82-03534

GROUND WATER SEEPAGE IN LAKE WASHINGTON AND THE UPPER ST. JOHNS RIVER BASIN, FLORIDA,
New Hampshire Water Supply and Pollution Control Commission, Concord.
J. N. Connor, and T. V. Belanger.
Water Resources Bulletin, Vol 17, No 5, p 799-805, October, 1981. 7 Fig, 6 Tab, 11 Ref.

Descriptors: *Seepage, *Drainage effects, *Chlorides, *Fate of pollutants, Lake Washington, St. Johns River, *Florida, Lakes, Groundwater movement, Water quality, Hydrologic budget, Drainage canals, Aquifers.

Direct groundwater seepage measurements in St. Johns River and Lake Washington, Florida, showed that drainage canals entering the lake had high average seepage rates (17.7 liters per sq m per day). Seepage from the lake shores was 2.01 liters per sq m per day. Total inputs into the lake were: St. Johns River, 88.3%; canal discharge, 5.9%; precipitation, 5.1%; and groundwater seepage, 0.7%. Outputs were: St. Johns River, 92.5%; evaporation and evapotranspiration, 4.6%; treatment plant pumpage, 1.9%; groundwater recharge, 0.6%; and marsh storage, 0.4%. Although the drainage canals represented 6.6% of St. Johns River annual discharge, the canals contributed 20.4% of the annual river chloride loading. Chloride contributions were highest during the dry season. Midlake Cl levels were 71 mg per liter; canal water levels, 108-131 mg per liter. Lake seepage water contained 72 mg per liter Cl; and canal seepage water, 215 mg per liter. This study indicated that rising levels of Cl in the river through the years are attributable to groundwater seepage in the headwaters, which have been subjected to channelization, marsh drainage, and diking. (Cassar-FRC)
W82-03546

BOTTOM SEDIMENTS AS A SOURCE OF NITROGEN AND PHOSPHORUS IN WATER,
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
For primary bibliographic entry see Field 5B.
W82-03571

PROBABILISTIC MODEL OF LONG-TERM FLUCTUATIONS ON THE LEVEL OF AN OPEN LAKE,
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
A. V. Frolov.
Water Resources, Vol 8, No 1, p 1-12, January/February, 1981. 4 Fig, 2 Tab, 32 Ref. Translated from Vodnye Resursy, No 1, p 34-47, January/February, 1981.

Descriptors: *Water level fluctuations, Streamflow, *Lakes, Evaporation, Open lakes, *Surface runoff, *Model studies, Lake Ladoga, Neva River, *USSR, Water budget, Rivers.

A model is presented for long-term fluctuations in levels of humid zone open lakes, where the surface runoff far exceeds other discharges in the water balance. In lakes of this type, evaporation and surface area are of minor importance. Results showed that open lakes normalize level fluctuations more weakly than closed lakes. The lake level and outflow are described by second-order autoregression processes. The model was used on data for Lake Ladoga and the Neva River. There was good agreement between observed and calculated water levels. (Cassar-FRC)
W82-03572

SULFUR AND OXYGEN ISOTOPES AS TRACERS OF THE ORIGIN OF SULFATE IN LAKE CRETEIL (SOUTHEAST OF PARIS, FRANCE),
Paris-6 Univ. (France). Lab. de Geologie Dynamique.
A. Chesterikoff, P. Lecolle, R. Letolle, and J. P. Carbonnel.
Journal of Hydrology, Vol 54, No 1-3, p 141-150, December, 1981. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Water quality, *Oxygen, *Isotopic tracers, *Sulfur, *Lakes, Geohydrology, Oxygenation, Aquifers, Biological oxygen demand, Groundwater, Sulfates, Groundwater movement, Piezometers, Isotope studies, Minerals, Salinity, *Lake Creteil, *France.

As part of long-term studies to preserve the water quality of Lake Creteil, France, interdisciplinary studies were conducted to uncover the origin, path and history of the waters. Isotopic studies of dissolved sulfate have allowed for the improvement of the hydrogeological model of the Creteil plain by identifying two sources of its water and their mineral content. The first source is an interstitial water or a confined low-conductivity aquifer with high sulfate concentrations. Sulfate from this source has a heavier isotopic composition, possibly through reduction, and may have originated in Paris gypsum. These waters are found to the west of Mt. Mesly down to the piezometric level. The second source consists of waters of low salinity and isotopic light sulfate from oxidation of sulfides or fertilizers. These waters are found down the Bois de la Grange Plateau. It is recommended that isotopic data be used in conjunction with other measurements to prevent false assumptions about the origin and characteristics of natural waters. (Geiger-FRC)
W82-03583

ORTHOPHOSPHATE AND ITS FLUX IN LAKE WATERS,
Department of Scientific and Industrial Research, Taupo (New Zealand). Freshwater Section.
E. White, G. Payne, S. Pickmere, and F. R. Picks.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 10, p 1215-1219, October, 1981. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Lakes, *Phosphates, *Radioactive tracers, *Chromatography, Nutrients, *Orthophosphates, Phosphorus, Particulate matter, Molybdenum, Separation techniques, Tracers, Dissolved solids, *New Zealand.

The relative distribution of reactive high molecular weight phosphorus (RHMW-P) and low molecular weight phosphorus (PO-P) in lake waters as well as the turnover times and presumed flux of phosphate between solution and particulate matter were studied in several New Zealand lakes by molybdenum blue technology and Sephadex gel (G25-150) chromatography. PO4-P is as near to representing orthophosphate as is possible to attain using molybdenum blue technology. Results showed that RHMW-P was not usually the dominant component of dissolved reactive phosphorus and was not solely responsible for incorrect calculations of orthophosphate levels estimated by molybdenum blue and radiotracer technology. Orthophosphate concentrations may be miscalculated when chemically reactive organic phosphorus is present in low molecular weight material (PO-P) and when radiotracer estimates are used. When radioactive PO4-derived turnover times are used to estimate changes in orthophosphate concentrations from solution to particulate matter, errors are likely to occur regardless of the method used to calculate orthophosphate levels. (Geiger-FRC)
W82-03613

A NOTE ON THE DEVELOPMENT OF THE THERMOCLINE IN TEMPERATE LAKES,
Indiana Univ.-Purdue Univ. at Indianapolis. Dept. of Geology.
P. De Caprariis.
Ecological Modelling, Vol 12, No 4, p 213-219, May, 1981. 1 Fig, 9 Ref.

Descriptors: *Lakes, *Mathematical models, *Thermocline, *Temperature gradient, Mathematical studies, Model studies, Mathematical equations, Thermal stratification, Epilimnion, Hypolimnion, Wind, Turbulent flow.

The Sundaram and Rehem model of the development of thermocline in temperate lakes allow vertical heat flux to vary with depth and is based on a balance between thermal buoyant forces and wind induced turbulence. An exact solution to the governing equation set forth by the Sundaram and Rehm model is presented for one assumption about the form of thermal diffusivity. The solution is presented as a transcendental relation between the temperature gradient and water depth, and the development of the thermocline is associated with a singular point of the governing equation. The exact solution shows the qualitative features of the numerical solution, and it may be used by modelers to obtain variations in temperature gradient with depth when a data set for a lake is deficient. The equations may also be manipulated to estimate the depth of the thermocline directly. (Geiger-FRC)
W82-03622

IRON OXIDE FROM A SEASONALLY ANOXIC LAKE,
Freshwater Biological Association, Ambleside (England).
E. Tipping, C. Woof, and D. Cooke.
Geochimica et Cosmochimica Acta, Vol 45, No 9, p 1411-1419, September, 1981. 4 Fig, 1 Tab, 35 Ref.

Descriptors: *Iron oxides, *Particulate matter, *Sedimentation, Metals, *Lakes, Iron compounds, Oxidation, Stratification, Thermal stratification, Chemical reactions, Esthwaite water, Adsorption, Flocculation, Lake sediments, Humic acids, Organic matter, *United Kingdom.

Ferric oxide particles taken from Esthwaite Water, United Kingdom, during the thermal stratification period and accompanying deep water anoxia are amorphous, spherical to ellipsoidal, with diameters 0.05 to 0.5 microns. They occur at levels of 3 mg Fe per liter or about 400 billion particles per liter. The iron oxide particles apparently do not consist of aggregates of primary particles, probably because they form slowly at low supersaturation. The particles are formed by oxidation of Fe(2+) in water and sediments. The role of bacteria in formation of these particles cannot be clearly defined. The chemical analysis of 4 samples showed 32-39% Fe, 14-18 C, 4-7% humic C, 1.5% N, 0.3-1.4% Mn, and 1-3% P with 1% or less each of Ca, Mg, Si, and S. The iron oxide particles are negatively charged because of adsorbed humic matter, phosphate, and silicate. The electrophoretic mobility in lake water (pH 6.7) is -1.3 times 10 to the minus 8th power sq meters per V per sec at 10 C, similar to pure iron oxide samples in lake water. A zeta potential of -27mV accounts for the high degree of dispersion of particles in the water. Adjusting the pH to < 5.5 (zeta potential < 20 mV) produces rapid flocculation. The observed peak of particulate iron at maximum deep water anoxic conditions is a result of ferrous oxidation exceeding ferric oxide sedimentation and reduction of sedimenting oxide. (Cassar-FRC)
W82-03643

NEUSIEDLERSEE: A PUZZLE FOR SCIENTISTS, A CHALLENGE FOR PLANNERS,
Vienna Univ. (Austria). Zoologisches Inst.
H. Loffler.
Nature and Resources, Vol 17, No 3, p 10-14, July-September, 1981. 4 Fig, 2 Tab.

Descriptors: *Nutrients, *Saline lakes, *Aquatic plants, *Neusiedlersee, Austria, Hungary, Lakes, Recreation, Wildlife, Eutrophication, Water level fluctuations, Water management, Water budget, Water pollution effects.

The Neusiedlersee, a large shallow (1.3 m average depth) lake on the Austria-Hungary border, presents problems for planners and managers. The lake level fluctuates widely. Reeds cover vast areas of water. The water budget, which varies with the climate, has not been clearly defined. Water entering the northern and western part of the lake is alkaline; water entering the southern part is saline. Anthropogenic influences (recreation, nutrient input, and commerical fishing) threaten the shoreline, water quality, and wildlife. In 1980 an Austrian-Hungarian commission was established to manage the lake. Limnologists and managers need much more information on this unusual lake: extent of the catchment area, water and salt budgets, tectonic origin of the lake, seiches, movements of the sediments, and the nutrient dynamics of the reed belt. (Cassar-FRC)
W82-03689

FAUNAL ASSEMBLAGES OF SOME SALINE LAKES NEAR MARCHAGEE, WESTERN AUSTRALIA,
Western Australia Univ., Nedlands. Dept. of Surgery.
S. A. Halse.
Australian Journal of Marine and Freshwater Research, Vol 32, No 1, p 133-142, 1981. 1 Fig, 3 Tab, 27 Ref.

Descriptors: *Saline lakes, *Invertebrates, *Salt tolerance, Lakes, *Australia, *Fauna, Benthic fauna, Aquatic fauna, Fish, Species distribution, Species diversity, Ecological effects, Fish populations, Copepods, Amphipods.

Fauna in five saline lakes in western Australia were sampled 1 to 4 times during the period March to September 1979, an exceptionally dry year. These lakes ranged from 4 to 650 ha in surface area, 0.15 to 1.3 meters in maximum depth, and 10 to 71 o/oo in salinity. The four more saline lakes had similar faunal assemblages consisting of 6 to 8 species. The most weakly saline lake had 13 species (5 crustaceans and 8 insects). Fish (Pseudogobius olorum) were found only in one lake (salinity 55 o/oo). Copepods and occasionally cladocerans were dominant. Only the amphipod Austrochiltonia subtenuis and the dytiscid Necterosoma pensillatus were present in all five lakes. This study discovered that several species were living at greater salinities than was previously known: A. subtenuis at 71 o/oo (previous record 44 o/oo) and Mytilocypris mutiloides at 45 o/oo salinity (previous record, about 10 o/oo). N. pensillatus was found at generally lower salinities than in eastern Australia, and at a record low of 10.5 o/oo for the species. (Cassar-FRC)
W82-03704

SOLUBILITIES OF GYPSUM AND HALITE IN THE DEAD SEA AND IN ITS MIXTURES WITH SEAWATER,
Hebrew Univ., Jerusalem (Israel). Dept. of Geology.
For primary bibliographic entry see Field 2K.
W82-03708

UNCERTAINTY ANALYSIS OF A LAKE EUTROPHICATION MODEL,
Michigan Univ., Ann Arbor.
D. Scavia.
PhD Thesis, 1980. 178 p, 21 Fig, 11 Tab, 88 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-17359.

Descriptors: *Mathematical models, *Error analysis, *Eutrophication, *Lakes, Water quality, Model testing, Monte Carlo method, *Saginaw Bay model.

The work presented is grouped into three areas: (1) comparison of error analysis by Monte Carlo simulation and by first-order error propagation (EKF in the absence of system observations), (2) calculation of error bounds on the Saginaw Bay model simulation output and the evaluation of relative contributions of various error sources (sensitivity analysis), and (3) use of the system model and observations for parameter estimation and system structure identification. Results from each of these three areas are discussed and recommendations for further investigation are given. (Sinha-OEIS)
W82-03711

ENVIRONMENTAL FACTORS AFFECTING THE GROWTH OF PHOTOSYNTHETIC BACTERIA IN LAKES,
Wisconsin Univ.-Madison.
T. B. Parkin.
PhD Thesis, August, 1980. 360 p, 22 Fig, 7 Tab, 164 Ref, 5 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-28198.

Descriptors: *Environmental effects, *Aquatic habitats, *Lakes, *Light intensity, *Photosynthetic bacteria, Hydrogen sulfide, Light penetration, Light quality, Color, *Primary productivity.

Photosynthetic bacteria are found in a wide variety of aquatic habitats. In the water columns of lakes, purple and green sulfur bacteria can develop large population densities at the depth where two key

requirements for growth, light and hydrogen sulfide, are present. This study was designed to investigate the effects of light and hydrogen sulfide on the activities of photosynthetic bacteria in lakes. It was found that the color of light penetrating to the sulfide-containing waters in lakes has a major role in determining which types of phototrophs develop. In one lake, red light penetrated to the greatest depth and only green sulfur bacteria capable of using red light were present. In the other lakes, primarily green light penetrated to the sulfide-containing waters and the carotenoid-rich purple bacteria capable of using these wavelengths of light predominated. The effects of light intensity were determined by evaluating the extent to which primary production by the photosynthetic bacteria in seven lakes was influenced by light intensity. A high correlation between primary production by these organisms and light intensity was observed. Production by these organisms did not correlate with either standing crop or sulfide concentration. The study of the effects of sulfide was confined to the bacterial population of a single lake. Rates of sulfide turnover at the thermocline region were estimated by monitoring sulfide oxidation and sulfate reduction rates. Also, the effects of sulfide concentration on photosynthesis and the relationships between sulfide oxidation and carbon fixation rates by this population were elucidated. (Sinha-OEIS)
W82-03712

SULFATE REDUCTION IN THE SEDIMENTS OF A EUTROPHIC LAKE,
Michigan State Univ., East Lansing. Dept. of Microbiology.
R. L. Smith.
PhD Thesis, 1981. 142 p, 19 Fig, 11 Tab, 150 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-26554.

Descriptors: *Sediments, *Eutrophic lakes, *Bacteria, *Sulfates, Carbon cycle, Lake sediments, Sulfate-reducing bacteria, *Sulfate reduction.

This study has demonstrated that high rates of sulfate reduction occur in the sediments of eutrophic lakes despite low interstitial sulfate concentrations. Although profiles of organic sulfur and hydrogen sulfide concentrations suggest otherwise, dissimilatory sulfate reduction appears to be the major mechanism of hydrogen sulfate production. Sulfate-reducing bacteria isolated from these sediments can utilize a wide array of substrates for carbon and/or electron donors; substrates that are typically found in eutrophic sediments. Mineralization experiments in the presence and absence of an inhibitor of sulfate reduction also indicate that sulfate reducers utilize an array of substrates as electron donors and are of potential significance to the in situ mineralization of lactate, propionate, and free amino acids. Based on these results a scheme conceptualizing sulfate reduction in anoxic sediments as it relates to carbon flow is given. The figure demonstrates that sulfate-reducing bacteria can be involved with each major step of oxidative carbon metabolism; the magnitude of the involvement is dependent primarily upon the sulfate concentration available. Ample evidence indicates that when the sulfate concentration is sufficient sulfate reduction mediates carbon flow. (Sinha-OEIS)
W82-03722

2I. Water In Plants

A FIELD STUDY WITH NITROGEN-15 OF SOIL AND FERTILIZER NITRATE UPTAKE AND OF WATER WITHDRAWAL BY SPRING WHEAT,
Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (Germany, F.R.).
O. Strebel, H. Grimme, and H. Fleige.
Soil Science, Vol 130, No 4, p 205-210, October, 1980. 4 Fig, 1 Tab, 13 Ref.

Descriptors: *Soil water, *Nitrogen, *Wheat, *Uptake, *Soil-water-plant relationships, Nutrients, Nitrates, Cycling nutrients, Fertilizers, Field tests, Crop production, Plant water potential, Loess, Soil solution, *West Germany.

The uptake of nitrate and water by spring wheat as a function of soil depth and time was studied in field tests on a Parabrainerde (Udalf) soil of West Germany, formed from loess. Radioactively-labeled nitrogen fertilizer was applied three times before sowing, and nitrate levels in the soil solution, soil water content, and soil water suction were determined by suction probes, a neutron meter and tensiometers, respectively. Total vertical water flow, capillary water flow, root water flow, labeled fertilizer, total soil nitrate levels and apparent mass flow of nitrate to roots were calculated and compared to nigrogen uptake at four harvests taken at the first node stage, anthesis, milk stage and maturity. Total uptake of nitrogen at the four harvest stages was 85, 134, 164, and 197 kilograms/hectare, of which 82, 71, 57, and 50% respectively were derived from the labeled fertilizer. The arable layer provided 76% of the total nitrogen uptake by mass flow and 62% of the total water uptake. The low contribution of mass flow to nitrogen supply was attributed to relatively low nitrate concentrations and a favorable water regime. (Geiger-FRC)
W82-03410

THE EFFECT OF ORGANIC MATERIAL AND INORGANIC IONS ON THE PHOTOSYNTHETIC RATE OF RED ALGA BOSTRYCHIA BINDERI FROM A FLORIDA ESTUARY,
University of South Florida, Tampa. Dept. of Biology.
For primary bibliographic entry see Field 2L.
W82-03423

DROUGHT RESISTANCE OF SORGHUM BICOLOR L. MOENCH. 3. SEED GERMINATION UNDER OSMOTIC STRESS,
Saskatchewan Univ., Saskatoon. Dept. of Crop Science.
D. G. Stout, G. M. Simpson, and D. M. Flotre.
Canadian Journal of Plant Science, Vol 60, No 1, p 13-24, January, 1980. 8 Fig, 4 Tab, 21 Ref.

Descriptors: *Drought resistance, *Osmotic pressure, *Germination, Salt balance, Seeds, Growth rates, *Sorghum, Drought, Soil-water-plant relationships.

An in-depth study was conducted of the germination characteristics of two sorghum cultivars previously shown to have different germination characteristics. Since plant hormones are believed to affect drought response of seedlings and adult plants, the effect of plant hormones on seed germination under different osmotic conditions was also examined. The germination responses of the two cultivars were also compared in soil and in different osmotic solutions. The findings support the earlier report that cultivar NK300 has better germination ability than the cultivar M35 under conditions of osmotic stress. These findings demonstrate a genuine difference in seed germination under drought stress. The osmotic solutions (D-mannitol, sucrose and polyethylene glycols) had little effect on the total amount of water taken up by sorghum seeds. The slight reduction in water uptake of seeds exposed to osmotica, compared to seeds exposed to water, may be related to the osmotica inhibiting cell wall expansion. NK300 seeds germinated better than M35 seeds at low water potential. Osmotic stress inhibition of germination is not due to decreased water uptake but instead appears to be due to an inhibition of metabolism in cells which have sufficient turgor potential to permit cell expansion. (Baker-FRC)
W82-03479

MOVEMENT OF CADMIUM AND WATER IN SPLIT-ROOT WHEAT PLANTS,
Oklahoma State Univ., Stillwater. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W82-03662

2J. Erosion and Sedimentation

SOME SUSPENDED SEDIMENT YIELDS FROM SOUTH ISLAND CATCHMENTS, NEW ZEALAND,
Ministry of Works and Development, Christchurch (New Zealand). Water and Soil Div.
G. A. Griffiths.
Water Resources Bulletin, Vol 17, No 4, p 662-671, August, 1981. 4 Fig, 5 Tab, 38 Ref.

Descriptors: *Suspended sediments, *Precipitation, *New Zealand, South Island, Catchments, Rainfall, Runoff, Mathematical studies, Sedimentation, *Sediment yield.

Instantaneous suspended sediment concentration and water discharge data were collected at 50 sites throughout South Island, New Zealand. Suspended sediment concentration and corresponding water discharge data were plotted on logarithmic paper. Tentative specific annual suspended sediment yield prediction equations were derived for four specific regions of South Island. An absolute error range, together with the factorial standard errors of the yield prediction equations, have been stated so that an appropriate error value may be deduced for the design of sedimentation aspects of engineering works. The yield prediction equations are not applicable to sites located downstream of major sediment storage basins. It is inferred that lakes and reservoirs effect a reduction in sediment yield through attenuation of flood hydrographs, because suspended sediment concentration ratings were observed to recover to their predam or upstream of lake values within tens of kilometers downstream from storage basins. A guide is given for the estimation of bedload yield by assuming it to be a stated proportion of suspended load yield. Rainfall was the most important parameter considered in terms of influence on suspended sediment yield production. Intensity, frequency, and duration of storms appear to explain the differences in specific yield production between regions for basins having similar rainfalls. (Baker-FRC)
W82-03411

AN EVALUATION OF THE SEDIGRAPH AS A STANDARD METHOD OF SEDIMENT PARTICLE SIZE ANALYSIS,
Hydrological Research Inst. Pretoria (South Africa).
For primary bibliographic entry see Field 7B.
W82-03437

SIZE DISTRIBUTION OF AMAZON RIVER BED SEDIMENT,
Geological Survey, Denver, CO.
C. F. Nordin, Jr., R. H. Meade, W. F. Curtis, N. J. Bosio, and P. M. B. Landim.
Nature (London), Vol 286, No 5768, p 52-53, July 3, 1980. 3 Fig, 9 Ref.

Descriptors: *River beds, *Bottom sediments, Size distribution, *Particle size, *Amazon River, South America, Brazil, Sediment transport, *Sediment distribution, Sand.

Samples of streambed material collected from the Amazon River and its major tributaries along a reach of the river from Iquitos, Peru, about 3,500 kilometers above Macapa, Brazil, to a point 220 kilometers above Macapa were subjected to particle size analyses. Samples collected with pipe dredges or with a US BM-54 bed material sampler were dried aboard ship and transported to the United States for particle size analysis by sieving or by pipette-visual accumulation tube methods. Sample analyses showed that the bed of the Amazon is mostly fine sand. The Amazon River does not show the trend of decreasing particle size for bed material in the downstream direction which is usually found in alluvial streams. Samples taken at several cross-sections demonstrated that the cross-channel variation in particle size at many locations was at least as great as the downstream variations for the entire 3,300 kilometer distance. While the median particle size and sorting coefficient were essentially constant along the Amazon mainstream reach examined, the composition of the bottom sands in the same reach varied significantly. Sands collected near Iquitos contained a larger proportion of dark mineral grains and rock fragments, indicating a predominantly Andean source. Sands in the lower 2,000 kilometer stretch studied contained higher proportions of zircon and tour-

maline and fewer unstable minerals, indicating a dilution of the mainstream material by sands brought in by tributaries from the Precambrian shield areas to the north and south of the river. (Carroll-FRC)
W82-03488

MOVEMENT OF BED MATERIAL IN A SMALL REACH OF A PERENNIAL STREAM,
Clark Univ., Worcester, MA. Dept. of Geography.
A. Zahavi.
PhD Thesis, 1981. 184 p, 20 Fig, 16 Tab, 13 Map, 74 Ref, 6 Append. University Microfilm International, Ann Arbor, MI; Order No GAX 81-18828.

Descriptors: *Sediment transport, *Stream discharge, *Bed load, Saltation, Erosion, Sedimentation, Geomorphology, Spatial distribution, Temporal distribution, Discharge capacity, Bedload discharge, New England.

The underlying and fundamental relations determined in this study are presented in the form of general conclusions. The following three general conclusions appear to be highly reliable: (1) Particle movement is an interaction between stream bed macro morphology and the particle physical properties such as the three axes, shape and weight; (2) Movement is related inversely to a particle's three axes and its weight; and (3) The small particles show a smaller mean distance of movement than that which would be expected if the relation of size with movement were continuous for all particles. In New England, generally only smaller bed particles move during the low summer flows. Larger particles would only be moved during the larger flow of the spring snow melt or by the higher magnitude lower frequency events associated with individual severe storms. This study inquires into the relations between the temporal and spatial discharge patterns and how they affect bedload transport within a small New England stream. (Sinha-OEIS)
W82-03516

BEDLOAD TRANSPORT IN AN OREGON COAST RANGE STREAM,
Georgia Pacific Corp., Fort Bragg, CA.
S. J. O'Leary, and R. L. Beschta.
Water Resources Bulletin, Vol 17, No 5, p 886-894, October, 1981. 9 Fig, 23 Ref.

Descriptors: *Bed load, *Sediment sampler, *Sediment transport, *Flynn Creek, *Oregon, Coastal streams, Streambeds, Streamflow, Sampling.

Two types of sediment samplers (vortex tube and Helley-Smith pressure differential) were used to measure bedload transport for three major storms at Flynn Creek, Oregon. The vortex tube was inefficient in trapping particles < 10 mm in diameter. After adjusting transport rates for this deficiency, results were still only 42-47% of those obtained with the Helley-Smith sampler. Problems with plugging in the Helley-Smith 0.2 mm mesh bag were partially overcome by increasing the bag size threefold and reducing the sampling time to less than 15 sec. Generally, bedload transport increased with increased streamflow. There were large and rapid fluctuations in bedload transport rates even during times of constant streamflow. Some of the possible reasons for the nonuniform sediment transport are: (1) nonuniform channel geometry (pool and riffle), (2) nonuniform particle size, and (3) transient flows in response to precipitation. (Cassar-FRC)
W82-03548

PARTICLE COUNTER FOR SEDIMENT TRANSPORT STUDIES,
Washington Univ., Seattle. Dept. of Oceanography.
For primary bibliographic entry see Field 7B.
W82-03666

SEDIMENT TRANSPORT BY RAINSPLASH,
Washington Univ., Seattle.
C. J. McCarthy.
PhD Thesis, February, 1980, 228 p, 38 Fig, 2 Tab, 117 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-26269.

Descriptors: *Rainfall impact, *Model studies, *Sediment transport, Slopes, Erosion, Particle size, Rainsplash, Single-drop transport law, Sediment size, Raindrop size.

A model is presented of sediment transport by rainsplash which contains substantial improvements over previous models. The model represents the sediment transport by rainstorms as the sum of the transport of the constituent drops. The dynamics of splashing are modeled qualitatively, and the results used to suggest the form of an empirical transport law for single drops. The single-drop transport law is obtained from analysis of data from detailed observations of rainsplash transport. The model connects the single-drop law with rainfall possessing any drop-size distribution, and is unique in its ability to predict rainsplash transport for any rainfall conditions and under a wide range of sediment sizes and slope angles. Hillslope evolution is modeled using the rainsplash transport law. The situations modeled include an isolated ridge, a weak layer between resistant layers, and the effects of changing base level. This is the first study to model hillslope evolution using a realistic transport law developed for a specific process. (Sinha-OEIS)
W82-03709

FACTORS AND MECHANICS OF BLUFF EROSION ON WISCONSIN'S GREAT LAKES SHORELINES,
Wisconsin Univ.-Madison.
R. J. Sterrett.
PhD Thesis, May, 1980. 390 p, 45 Fig, 14 Tab, 53 Ref, 7 Photo, 13 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-20581.

Descriptors: Erosion, *Erosion rates, Groundwater, Water table fluctuations, Groundwater movement, Slope stability, Solifluction, Rill erosion, Creep, *Shores, *Great Lakes, *Wisconsin, Shoreline recession, *Bluff erosion.

The principal objectives of this study were to quantify the rates of erosion and removal of material from the slope by the processes of sheetwash and rill erosion, slumps, and solifluction. The field investigations were conducted at eight sites on Wisconsin's Great Lakes shorelines. The influence of ground water on slope stability was also investigated. This investigation included defining groundwater gradients, position, and water-level fluctuations within the bluffs. The results of the study indicate that most soil loss occurs during the spring thaw. Up to 96% of all soil lost from a bluff face can occur in the spring as the result of slab slides and mudflows. Large rotational slumps are infrequent in occurrence and contribute only a small percentage of material lost. Sheetwash and rill erosion were found to be effective processes in removing material from the bare soil bluff faces. Ground water is an important factor which is significant in understanding slope stability. Field and computer studies showed that there are two minimally interconnected flow systems operating at several sites on Lake Michigan. One system is within the fractured till at the top of the bluff, and the second is within a sand lens. Water-level fluctuations within the upper fractured till are important in overall stability. Water-table fluctuations along one stretch of Lake Michigan's shoreline appear to be the triggering mechanisms for a 10-meter bluff top recession which occurred in six months. (Sinha-OEIS)
W82-03720

2K. Chemical Processes

HYDROCHEMICAL BALANCE OF AN ALPINE WATERSHED IN SOUTHEAST ALASKA,
Tongass National Forest, Ketchikan, AK.
J. D. Stednick.
Arctic and Alpine Research, Vol 13, No 4, p 431-438, November, 1981. 1 Fig, 4 Tab, 21 Ref.

Descriptors: *Water quality, *Alpine regions, *Chemical composition, Watersheds, *Indian River, *Alaska, Weathering, Minerals, Precipitation, Streams, Surface water.

The water quality balance of Upper Indian River, Chicagof Island, Alaska was investigated during 1979 and 1980. The 8 sq km watershed had an average streamflow of 2825 mm and annual precipitation of 3300 mm. There were net increases in orthophosphate (0.4 kg per ha per year) and in sodium (1.4 kg per ha per year). There were losses (expressed in kg per ha per year) in total nitrogen, 5.9; mg, 5.1; Ca, 475.5; silica, 55.2; sulfur, 36.+5; chloride, 71.3; and potassium, 12.4. Total phosphorus output equaled precipitation input. The major sources of most elements were weathering of rocks and deposition of ocean salts with precipitation. (Cassar-FRC)
W82-03402

RELATION BETWEEN PHC AND SODIUM ADSORPTION RATIO (SAR) AND AN ALTERNATIVE METHOD OF ESTIMATING SAR OF SOIL OR DRAINAGE WATERS,
Science and Education Administration, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 2G.
W82-03445

WATER CHEMISTRY OF ALABAMA PONDS,
Auburn Univ., AL.
R. G. Arce.
PhD Thesis, June, 1980. 47 P, 20 Fig, 9 Tab, 23 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-18173.

Descriptors: *Water analysis, *Chemical analysis, *Ponds, Soil water, Hardness, Alkalinity, Chemical properties, Watershed management, Fish ponds, *Environmental effects, *Alabama.

Waters from Alabama fish ponds from five soils areas were dilute solutions of alkaline earth carbonates and bicarbonates. Waters also contained low concentrations of sodium, potassium, chloride, and sulfate and trace quantities of iron, manganese, zinc, and copper. Nitrogen and phosphorus concentrations were not measured. The total concentration of ions (averages) by soils area were in the following order: Piedmont Plateau to Coastal Plains to Appalachian Plateau to Limestone Valley and Uplands to Prairies. Differences in total ionic concentrations resulted primarily from differences in carbonate and bicarbonate (total alkalinity) and calcium and magnesium (total hardness) concentrations. Waters of a particular soils area often differed considerably in concentration of all variables, resulting in skewed distributions of data. Therefore, data are presented in histograms for each chemical species and each soils area. Means and standard errors are also presented. Many relationships existed between ions, but few were strong enough to be useful in predicting ionic concentrations. The most useful relationship involves the use of the sum of total hardness and total alkalinity to estimate total ionic concentrations. Watershed management practices did not greatly affect concentrations of major ions, but ponds in woods often had organically stained water, those in pastures often had plankton blooms, and the ones filled by runoff from watershed planted to row crops were often turbid with suspended soil particles. (Sinha-OEIS)
W82-03534

THE ORIGIN AND EVOLUTION OF SALINE FORMATION WATER, LOWER CRETACEOUS CARBONATES, SOUTH-CENTRAL TEXAS, U.S.A.,
Texas Univ. at Austin. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2F.
W82-03540

MINOR - ELEMENT DISTRIBUTION IN MINERAL AND THERMAL WATERS (REPARTITION DES ELEMENTS TRACES DANS LES EAUX THERMO-MINERALS),

Grenoble Univ. (France). Unite de Geologie et de Pharmacie.
For primary bibliographic entry see Field 2F.
W82-03541

GEOCHEMICAL AND ISOTOPIC CHARACTERISTICS OF SPRING AND GROUNDWATER IN THE STATE OF SAO PAULO, BRAZIL,
Sao Paulo Univ. (Brazil). Inst. de Geociencias.
For primary bibliographic entry see Field 2F.
W82-03542

FACTORS OF THE CHEMICAL COMPOSITION OF SEEPAGE AND GROUNDWATERS IN THE INTERTROPICAL ZONE (WEST AFRICA),
Organisation de Recherche Scientifique-Technique d'Outre-Mer, Paris (France).
E. J. Roose, and F. Lelong.
Journal of Hydrology, Vol 54, No 1-3, p 1-22, December, 1981. 6 Fig, 4 Tab, 20 Ref.

Descriptors: *Minerals, *Groundwater, *Chemical properties, *Seepage, *Tropic zone, Drainage, Surface drainage, Hydrogen ion concentration, Soil profiles, Soil science, Spring water, Runoff, Rainfall, Physicochemical properties, Organic carbon, Cations, Anions, *West Africa.

During four to eleven years of field studies, 5,000 samples of rainfall, throughfall, runoff, drainage, and groundwater were examined as part of a research program on the dynamics of the ferralitic and ferruginous soils of West Africa. All of the water samples analyzed were slightly mineralized, with increasing mineralization from rainfall water to seepage water at 2 m depth. The mineral content generally decreased at the water table level except for Si and Na content. The amounts of dissolved solids varied markedly with flow volumes and seasons. The factors governing the chemical composition of the groundwaters were very complex. The composition of water in the soil layers was affected basically by biological and biochemical processes, while that of the groundwaters was dependent mainly upon physicochemical properties. (Geiger-FRC)
W82-03543

NATURAL TEMPORAL VARIATIONS IN THE CHEMISTRY OF SHALLOW GROUNDWATER, ATHABASCA OIL SANDS AREA, ALBERTA,
Stanley Associates Engineering Ltd., Edmonton (Alberta),
D. A. Hackbarth.
Canadian Journal of Earth Sciences, Vol 18, No 10, p 1599-1608, October, 1981. 6 Fig, 2 Tab, 24 Ref.

Descriptors: *Seasonal variation, *Water quality, *Groundwater level, *Gochemistry, Chemical composition, Athabasca Oil Sands, *Alberta, Calcium, Magnesium, Bicarbonates, Sulfates, Chlorides, Solutes, Sodium, Potassium, Carbonates, Nitrates, Silica, Water table fluctuations, Shallow wells, Groundwater recharge, Recharge.

The chemistry of shallow groundwater in the Athabasca oil sands area, Alberta, showed annual variations during sampling conducted from 1977-1979. Three wells, 5 to 8 m deep, were located in an area with 99% natural vegetation within 30 miles of oil sands mining developments. Coefficients of variation were highest for nitrates, 100-132%, and for all parameters averaged 34% for the well sampled monthly and 11 and 21% for the two wells sampled bimonthly. The annual pattern of variation in chemistry of the shallow groundwater was related to the level of the water table. Calcium, magnesium, and bicarbonate concentration were lowest in spring, highest in summer. This is related to the carbon dioxide in the recharge water, controlled by the muskeg. Sulfates were highest in spring and fall, during periods of significant groundwater recharge. Chloride concentrations were highest in winter, lowest in spring and summer, reflecting the slower groundwater flow in winter and greater residence time in the chloride-bearing minerals. Water chemistry varied less at wells of greater depth. Coefficient of variation at 150 m was 4%. (Cassar-FRC)
W82-03611

'ACID RAIN', DISSOLVED ALUMINUM AND CHEMICAL WEATHERING AT THE HUBBARD BROOK EXPERIMENTAL FOREST, NEW HAMPSHIRE,
Dartmouth Coll., Hanover, NH. Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W82-03641

IDENTIFICATION OF CONNATE WATER IN INTERSTITIAL SOLUTION OF CHALK SEDIMENT,
Institute of Geological Sciences, Wallingford (England).
A. H. Bath, and W. M. Edmunds.
Geochimica et Cosmochimica Acta, Vol 45, No 9, p 1449-1461, September, 1981. 7 Fig, 4 Tab, 21 Ref.

Descriptors: *Connate water, *Geochemistry, *Groundwater dating, Chemical composition, Solute transport, Interstitial water, Pore water, Meteoric water, *Chalk formation, Isotope studies, Dating, Carbonate aquifers, Diagenesis, Geohydrology, Diffusion model.

The interstitial solution chemistry of core samples from a 594 meter borehole (41 m of glacial deposit, 472 m of carbonate) in the Upper Cretaceous Chalk formation near Norfolk, England, was investigated. In general, dissolved species (chloride, Na+, K+, Ca(2+), Mg(2+), bromide, sulfate, and Li+) were most dilute near the surface and increased in concentration with depth to a near-marine composition. Sr(2+) and fluoride concentrations decreased up to 100-200 meters depth and showed anomalous behavior at greater depths. O18 and D values for interstitial water became less negative with increasing depth and were correlated with the changes in salinity. The observed pattern of increasing salinity with depth suggests that meteoric water has diluted the interstitial water. The deepest water is connate, subsequently modified by diagenetic reaction. The same ratio of Na+:Cl- is maintained throughout the entire profile. Departures from the expected dilution trend (K+, Sr+, Li+, and fluoride) are probably a result of diagenetic reactions during burial or a result of freshwater circulation following uplift of the sediments. Analysis of the Chalk itself showed a general uniformity of Mg and Sr, despite a wide variation in interstitial solution compositions, suggesting that there was no general recrystallization of the carbonates. A diffusion model was applied to the dilution of the connate interstitial solution. The beginning of mixing was calculated at 3 million years age (late Tertiary). The discrepancy between stable isotope composition and chemical composition of interstitial solutions can be attributed to different diffusion rates of the water and solute species. (Cassar-FRC)
W82-03642

THE ORIGIN AND ISOTOPIC COMPOSITION OF DISSOLVED SULFIDE IN GROUNDWATER FROM CARBONATE AQUIFERS IN FLORIDA AND TEXAS,
Geological Survey, Lakewood, CO.
R. O. Rye, W. Back, B. B. Hanshaw, C. T. Rightmire, and F. J. Pearson.
Geochimica et Cosmochimica Acta, Vol 45, No 10, p 1941-1950, October, 1981. 5 Fig, 2 Tab, 27 Ref.

Descriptors: *Aquifers, *Sulfides, Chemical composition, Groundwater, *Florida, *Texas, Hydrogen sulfide, Edwards aquifer, Floridan aquifer, *Carbonate aquifers.

Evidence is presented on the co-existing and simultaneously collected reduced sulfur species in a Florida aquifer. The total sulfur values of dissolved sulfide and the sulfur isotope fractionations between dissolved sulfide and sulfate species in the groundwater generally correlated with dissolved sulfate concentrations, which were related to flow patterns and residence time within the aquifer. The dissolved sulfide derives from the slow in situ biogenic reduction of sulfate dissolved from sedimentary gypsum in the aquifer. Where the water is the oldest, the dissolved sulfide apparently had attained isotopic equilibrium with the dissolved sulfate at the temperature of the system, which was 28 degrees C. This approach to equilibrium reflects an extremely slow reduction rate of the dissolved sulfate by bacteria. This slow rate probably results from very low concentrations of organic matter in the aquifer. In the reducing part of the Edwards aquifer, located in Texas, there was a general down-gradient increase in both dissolved sulfide and sulfate concentrations, but neither the total sulfur values of sulfide nor the sulfide-sulfate isotope fractionation correlated with the groundwater flow pattern. The dissolved sulfide species appeared to be derived mainly from biogenic reduction of sulfate ions, whose source is gypsum dissolution, even though upgradient diffusion of hydrogen sulfide gas from deeper oil field brines may be significant in some places. (Baker-FRC)
W82-03644

THE INFLUENCE OF PERIPHERAL SABKHAS ON THE GEOCHEMISTRY AND SEDIMENTOLOGY OF A TUNISIAN LAGOON: BAHIRET EL BIBAN,
K. Medhioub, and J. P. Perthuisot.
Sedimentology, Vol 28, No 5, p 679-688, October, 1981. 13 Fig, 2 Tab, 10 Ref.

Descriptors: Evaporation, *Saline water, *Tidal flats, Arid lands, *Geochemistry, Calcium sulfate, *Sedimentology, Chemical composition, Water circulation, *Lagoons, Sabkhas, Bahiret el Biban, *Tunisia.

Bahiret el Biban, a limited-circulation lagoon on the Tunisian coast, is separated from the Mediterranean by a narrow barrier broken by an inlet. On the inland border of the lagoon are sabkhas, or wide tidal flats now 0-2 m above sea level, which were formed from marine sediments. The chemical behavior of the lagoon was studied March 1976-August 1977. Water is more saline at greater distances from the seawater inlets. Salinity is higher in summer, when evaporation is greater than in winter, when freshwater dilution can take place. Water was more saline in 1977 than in 1976. Bottom waters are more concentrated than surface waters. Calcium sulfate is gradually lost, mostly by evaporitic evolution and sulfate reduction in the adjacent sabkhas. Here the interstitial waters are high in dissolved solids. This lagoon is a possible example of the early stages in evolution of an evaporatic basin. (Cassar-FRC)
W82-03684

SOLUBILITIES OF GYPSUM AND HALITE IN THE DEAD SEA AND IN ITS MIXTURES WITH SEAWATER,
Hebrew Univ., Jerusalem (Israel). Dept. of Geology.
A. Katz, A. Starinsky, N. Taitel-Goldman, and M. Beyth.
Limnology and Oceanography, Vol 26, No 4, p 709-716, July, 1981. 2 Fig, 5 Tab, 19 Ref.

Descriptors: *Saline lakes, *Saturation, *Solubility, Chemical precipitation, Lakes, Salts, Saline water, Gypsum, Calcium sulfate, Halite, Sodium chloride, Brines, *Dead Sea, Israel, Seawater.

The entire Dead Sea water column (ionic strength = 9-10) is saturated or slightly oversaturated with respect to both gypsum ($CaSO_4.2H_2O$) and halite (NaCl). This was determined by chemical analysis of mixtures of Mediterranean seawater (ionic strength = 0.8) and Dead Sea brines (ionic strength = 9) over the ionic strength range of 3 to 13. Higher ionic strength solutions were produced by evaporation. The practical solubility constants of gypsum were found to be related to the ionic strength by an empirical expression. The average degree of saturation for gypsum was 1.16 (range 1.08-1.43); for halite, 0.95-1.17. Summer temperatures are expected to decrease the gypsum saturation values in the upper 30 meters of water (at

ambient temperatures, 1.22-1.43) by 10-15%. (Cassar-FRC)
W82-03708

2L. Estuaries

ANALYSIS OF TEMPORAL CHANGES IN FISH ASSEMBLAGES IN SERPENTINE CREEK, QUEENSLAND,
Queensland Univ., Brisbane (Australia). Dept. of Zoology.
N. J. Quinn.
Environmental Biology of Fishes, Vol 5 No 2, p 117-133, April 22, 1980. 14 Fig, 4 Tab, 62 Ref.

Descriptors: *Fish populations, *Species diversity, *Seasonal variation, Estuaries, Bramble Bay, Serpentine Creek, *Australia, Temperature, Salinity, Biological communities, Time series analysis.

Nocturnal fish populations at 10 sites in Serpentine Creek and Bramble Bay, near Brisbane, Australia, were surveyed every two weeks from November 1975 to April 1977. Forty-five species from 34 families (14,518 individuals) were obtained. The six most abundant species accounted for 72% of the catch. Creek salinities and temperatures followed an annual cycle, which preceeded the bay by 1 month. Minimum salinity was found in February, and maximum temperature in January. The mean number of species and abundance of all fish conformed to a regular annual pattern, with maxima in April and May. Shannon and Gleason diversity indices showed no regular seasonal trends. Of the twenty-two most abundant species, seventeen demonstrated a regular annual cycle of abundance. Number, abundance, and diversity were greatest about 1 km upstream from the creek mouth and gradually declined upstream. Temperature and/or salinity were positively correlated with the abundance of 11 species. Fish were classified into 5 groups: resident (only Spheroides pleurostictus), transient (infrequent, sporadic), annual (possibly tolerant to variable abiotic conditions), abiotically influenced species (dependent on salinity/temperature), and seasonal (related both to abiotic values and to an annual cycle). The low proportion of resident species is consistent with Tyler's (1971) theory that temperature instability is reflected in instability in assemblages of fish species. (Cassar-FRC)
W82-03407

ON THE CONSPECIFICITY OF MARINE AND FRESHWATER BANGIA IN BRITAIN,
Liverpool Univ. (England). Hartley Botanical Labs.
R. H. Reed.
British Phycological Journal, Vol 15, No 4, p 411-416, December 1, 1980. 1 Fig, 22 Ref.

Descriptors: *Salt tolerance, *Algae, *Bangia, Salinity, Estuaries, Marine plants, *United Kingdom, Aquatic plants.

The salinity responses of marine (Port St. Mary, Isle of Man, United Kingdom) and freshwater (Leeds-Liverpool Canal at Wigan) Bangia isolates were studied in laboratory cultures to test the conspecific theory. After two generations immature germlings of the marine isolate were introduced into waters of varying salinity (natural seawater, freshwater and mixtures), where they grew over the whole salinity range. Growth was optimum in full-strength seawater. The freshwater isolates grew best in 1/16 to 1/2 seawater, and least well in 1/32 and full-strength seawater. Although most mature plants of the marine isolate died when placed in fresh water, a few cells in some thalli survived and formed a bottlebrush structure after 8-10 weeks dormance. These produced new plants, which did not reproduce. This evidence suggests a marine origin for freshwater Bangia and adds weight to the argument that the two are not separate taxa. (Cassar-FRC)
W82-03408

THE EFFECT OF ORGANIC MATERIAL AND INORGANIC IONS ON THE PHOTOSYNTHETIC RATE OF RED ALGA BOSTRYCHIA BINDERI FROM A FLORIDA ESTUARY,
University of South Florida, Tampa. Dept. of Biology.
C. J. Dawes, and R. P. McIntosh.
Marine Biology (Berlin), Vol 64, No 2, p 213-218, September, 1981. 6 Fig, 4 Tab, 24 Ref.

Descriptors: *Algal growth, *Estuaries, *Salinity, Photosynthesis, Nutrients, Sea water, Calcium, Spring water, *Florida.

Comparisons of photosynthetic rates were made on Bostrychia binderi held in seawater diluted to various salinities, artificial spring water, and distilled water to determine which components of spring water may be particularly important to the alga's survival in estuarine waters. The rate of photosynthesis increased with decreases in salinity. Higher photosynthetic rates when salinity was 0 and 5 ppt were partially due to increased levels of bicarbonate and various nutrients. When plants were held for three to seven days in spring water of low salinity (0-5 ppt), the higher calcium levels caused a higher photosynthetic rate. When salinity was 5 ppt or higher, the effect of calcium on the photosynthetic rate was not apparent after 2 to 8 weeks due to acclimation. The diverse algal populations characteristic of estuaries on the west coast of Florida may be due at least in part to natural spring water mixing with the seawater and sustaining the algae over short periods of low salinity. (Small-FRC)
W82-03423

ESTUARINE DISTRIBUTION OF SAPROLEGNIACEAE IN THE TAMPA BAY AREA: I,
University of South Florida, Tampa. Dept. of Biology.
D. Tes. Wagner-Merner.
Botanica Marina, Vol 23, No 11, p 707-709, November, 1980. 2 Tab, 14 Ref.

Descriptors: *Estuaries, *Aquatic fungi, Distribution patterns, *Tampa Bay, Salinity, Nutrients, Growth.

This study attempted to determine what Saprolegniaceae are distributed in a small estuary in the Tampa Bay Area. Bullfrog Creek, the area studied, is located in the heart of the county agricultural district but is subject to minimal agricultural drainage. The collecting of Saprolegniaceae from the estuary was carried out by laboratory or in situ hemp seed baiting techniques. It appeared from the findings of the study that some species of Saprolegniaceae are limited in their occurrence in southeastern estuaries. No evidence was forthcoming that a correlation existed in fungal distribution in a natural aquatic habitat between temperature and salinity tolerance. It is suggested that additional studies are needed on competition among water molds on quantified and equal baits in order to understand estuarine mycology more fully. (Baker-FRC)
W82-03469

STUDY OF THE TRANSFER OF CD, PB, CU AND ZN IN NERITIC AND ESTUARINE TROPHIC CHAINS - II. BIOLOGICAL ACCUMULATION IN PLANKTONOPHAGE FISH. (ETUDE DU TRANSFERT DE CD, PB, CU ET ZN DANS LES CHAINES TROPHIQUES NERITIQUES ET ESTUARIENNES-II. ACCUMULATION BIOLOGIQUE CHEZ LES POISSONS PLANCTONOPHAGES),
Institut des Sciences de la Nature, Nantes (France). Lab. d'Ecologie Animale et Biologie Marine; and Nantes Univ. (France). Lab. de Biologie Marine.
C. Amiard-Triquet, C. Metayer, J. C. Amiard, and R. Ferre.
Water Research, Vol 14, No 9, p 1327-1332, September, 1980. 2 Fig, 3 Tab, 20 Ref.

Descriptors: *Accumulation, *Heavy metals, *Fish, Metals, *Estuaries, *France, Crustaceans, Bioaccumulation, Copepods, Mysids, Path of pollutants, Food chains, Loire estuary.

Plankton-feeder fish (anchovies, sprats, garfish and herring) and their prey (mainly Copepods and Mysids) were obtained from the banks of Bilho and Pipy in the Loire estuary in August 1977 to October 1978. Trace element (Cd, Pb, Cu and Zn) concentrations in organisms from different levels of the food chains were compared using the transfer factor (the ratio of the concentration in the predator to that in the prey). This factor was generally lower than 1 for Cd, Pb and Cu but often higher than 1 for Zn. This does not conclusively indicate biomagnification of Zn in the food chain, since the level of Zn in the predator used to calculate the transfer factor results from the accumulation of both food and water. The differences observed between the two zoological groups were partly due to the fact that determinations were made after elimination of the digestive content for the fish, while for the crustaceans the digestive content was included. Analysis of the results and literature data indicate that the order of biological accumulation was $Cd < Pb = Cu < Zn$ in fish and $Cd < Pb < Cu < Zn$ in crustaceans. The difference was due to the metabolic role of Cu in crustaceans as a constituent of respiratory pigment. During digestion there was often a slight decrease of metal concentrations between the prey and stomach content, followed by an increase of the metal levels in intestinal contents compared to the stomach. (Hertzoff-FRC)
W82-03491

STUDY OF THE TRANSFER OF CD, PB, CU, AND ZN IN NERITIC AND ESTUARINE TROPHIC CHAINS - I. STATE IN THE INTERNAL ESTUARY OF THE LOIRE (FRANCE) DURING THE SUMMER OF 1978. (ETUDE DU TRANSFERT DE CD, PB, CU ET ZN DANS LES CHAINES TROPHIQUES NERITIQUES ET ESTUARIENNES - I. ETAT DANS L'ESTUAIRE INTERNE DE LA LOIRE (FRANCE) AU COURS DE L'ETE 1978),
Nancy-1 Univ. (France). Lab de Chimie et d'Electrochimie Analytique et d'Hydrologie.
For primary bibliographic entry see Field 5B.
W82-03492

DYNAMICS OF BACTERIOPLANKTON IN THE NEWPORT RIVER ESTUARY,
North Carolina State Univ. at Raleigh. Dept. of Marine Science and Engineering.
A. V. Palumbo.
PhD Thesis, 1980. 124 p, 16 Fig, 29 Tab, 107 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-00809.

Descriptors: *Estuaries, *Organic matter, *Bacteria, Plankton, Particulate matter, Dissolved oxygen, Amino acids, Dissolved organic carbon, *Newport River estuary, *North Carolina.

The numbers of the bacterioplankton and the turnover times of dissolved organic compounds in the Newport River estuary are comparable to the numbers and turnover times observed in other studies, especially those done in estuaries. Bacterial populations which occur in the riverine and estuarine areas respond to changes in pH, salinity, temperature and substrate concentration. Resuspension of benthic bacteria does not seem to be the source of the relatively high biomass and activity of the bacterioplankton in the upper estuary. However, release of DOC from the organic rich anaerobic sediments of the upper estuary could be very important. The data supports the hypothesis that the mid-salinity mixing basin above Cross Rock is the primary area of active bacterial growth. There seems to be much less activity and production of bacteria in the river and in the high salinity water of the lower estuary. The maximum bacterial activity and biomass occur during the warmest months and temperature is correlated positively with ADDC, PAV, and negatively with turnover time. The large quantities of DOC in the river do not seem to stimulate bacterial growth until the fresh water mixes with the salt water. The increased pH and perhaps the increased concentration of readily-degradable organic matter released from the shallow anaerobic sediments and from the phytoplankton results in the increase in bacterial numbers and activity in the upper estuarine mixing zone. The data on the respiration of amino acids by natural bacterial populations and the biomass of bacteria in

marine and estuarine waters support the hypothesis that bacteria are an important source of particular organic matter. (Sinha-OEIS)
W82-03520

REMOVAL OF HEXAVALENT CHROMIUM FROM ESTUARINE WATERS BY MODEL SUBSTRATES AND NATURAL SEDIMENTS,
Maine Univ. at Orono.
For primary bibliographic entry see Field 5G.
W82-03637

PHYSICAL MODELING OF ROTTERDAMSE WATERWEG ESTUARY,
Waterloopkundig Lab., Delft (Netherlands). Basic Research Div.
H. N. C. Breusers, and A. G. van OS.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1351-1370, November, 1981. 9 Fig, 13 Ref.

Descriptors: *Model studies, *Estuaries, Estuarine environment, Hydraulics, Mathematical models, Salinity, Sedimentation, Tides, Water quality, Navigation, *Rotterdamse Waterweg estuary, *Holland.

Modeling techniques are considered for the difficult case of the Rotterdamse Waterweg Estuary, where salt intrusion and water quality modeling impose great demands on the capabilities of the techniques employed. A thorough evaluation of the research possibilities of this area indicated that at present only a complementary approach with hydraulic and mathematical modeling is feasible. It was concluded that mathematical models do not yet yield the possibility to predict in sufficient detail the flow velocity and salinity field. Thus the main tool for estuarine problems is the physical scale model. Mathematical models can be used successfully for the study of transport of pollutants and sediments. A hydraulic scale model with a partial black-box character proves to be the most powerful tool for the study of estuaries, provided certain requirements are met. The hydraulic model should be calibrated very carefully, with special emphasis on the influence of possible scale effects due to distortion and Reynolds number influences. The verification tests of the physical model of this estuary proved that reproduction of water levels and flow pattern is possible to the required accuracy if proper boundary conditions are known. Mathematical models are useful in predicting discharges at model boundaries. The model sea boundary should be operated with discharge control. In this case, where wall roughness was dominant, no additional mixing was needed after calibration of the total roughness on the tidal propagation with bed elements. This model has been useful in providing support for management decisions related to the development of the estuary. (Baker-FRC)
W82-03671

HEATED DISCHARGE IN AN ESTUARY: CASE STUDY,
Worcester Polytechnic Inst., Holden, MA. Alden Research Labs.
J. B. Nystrom, G. E. Hecker, and H. C. Moy.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1371-1406, November, 1981. 26 Fig, 1 Tab, 20 Ref.

Descriptors: *Model studies, *Thermal pollution, *Estuaries, Temperature effects, Flow profiles, Heated water, Powerplants, *Nuclear powerplants, Rivers, Estuarine environment, *Hudson River, *Indian Point Nuclear Powerplant.

Two physical model studies were made to evaluate the thermal patterns produced in the Hudson River by the water discharged from the condenser cooling unit from the Indian Point Nuclear Generating Station. Tidal flows dominate the hydraulics of the receiving water body, the Hudson River, which is classed as a partially stratified estuary. Salt from the ocean intrudes into the estuary past the Indian Point site for freshwater flow rates less than about 20,800 cubic feet/second, and relatively strong vertical mixing causes vertical salinity gradients to be relatively weak. Similitude criteria are developed for the design of models to predict near field temperature patterns. These criteria are applied in conjunction with practical considerations. The undistorted near-field model was constructed to a scale of 1-75. Near-field thermal patterns were obtained to evaluate maximum temperature rises, direct recirculation, and to calibrate the distorted scale model outfall structure. The distorted scale model, constructed to a scale of 1-400 and a vertical scale of 1-800, was used to determine thermal patterns in the intermediate-far-field. Typical results show surface temperature rise patterns near the plant discharge and within a 15 mile reach load, and discharge structure geometries are illustrated. Model results are evaluated with respect to scale effects and limitations due to inability to simulate certain phenomena occurring in the field. Model results are compared to an extensive field survey program and a one-dimensional time averaged mathematical model. (Baker-FRC)
W82-03674

DEEP WATER RENEWAL IN SUBARCTIC FJORD,
Woodward-Clyde Consultants, Anchorage, AL.
J. M. Colonell.
Journal of the Waterway, Port, Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WW4, p 223-231, November, 1981. 6 Fig, 2 Tab, 9 Ref.

Descriptors: *Fjords, *Mixing *Water exchange, Subarctic zone, Surface water, Meteorological data collection, Estuaries, *Tidal effects, Tidal currents, Flushing, Current meters, Weather, *Port Valdez, Prince William Sound, *Alaska.

Port Valdez, at the marine terminal of the trans-Alaska Pipeline System, is located on a subarctic fjord. Currents were studied in Valdez Narrows for over 2 years to examine the exchange of water between the port and Prince William Sound. Surges of surface water from Prince William Sound into Port Valdez appear to be related to the passage of weather systems through southcentral Alaska. These events are random and cause variable flushing rates, probably of no more than several days according to outflow volumes recorded on current meter data. These observations suggest that a unique residence time for Port Valdez is inappropriate, but a composite residence time may be estimated at no more than a few weeks. These estimates depend upon assumptions of fairly uniform mixing throughout Port Valdez and should apply to other fjords of southcentral and southeastern Alaska and northern British Columbia. (Geiger-FRC)
W82-03675

MERCURY IN COASTAL AND ESTUARINE SEDIMENTS OF THE NORTHEASTERN IRISH SEA,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W82-03696

ENRICHMENT OF DISSOLVED PHENOLIC MATERIAL IN THE SURFACE MICROLAYER OF COASTAL WATERS,
Maine Univ. at Orono. Dept. of Oceanography.
D. J. Carlson, and L. M. Mayer.
Nature (London), Vol 286, No 5772, p 482-483, July, 1980. 3 Fig, 40 Ref.

Descriptors: *Estuaries, *Surface water, *Phenols, Bacteria, Microorganisms, Coasts, Enrichment, Dissolved solids, Saco River, *Maine, Damariscotta River, Industrial wastes, Salinity, Chemical properties, Coastal waters.

Ultraviolet absorbance, dissolved organic carbon (DOC), and phenolic material were examined in the bulk and surface microlayer waters of the Damariscotta and Saco River estuaries. The Damariscotta River estuary is a 30 m long, narrow embayment in central Maine with limited freshwater input, predominantly overflow from Damariscotta Lake. The Saco River is a major drainage system in southern Maine. Data from these estuaries demonstrate consistent microlayer enrichment of UV absorbance, and hence of phenolic material. DOC levels did not exhibit consistent enrichment. Most samples plot above the line of equal microlayer partitioning of UV absorbance and DOC. This indicates preferential enrichment of phenoloc material relative to other DOC. While the enrichment of phenolic material occurs at all salinities, it is greatest at higher salinities. This trend may be due to three factors. First, terrigenous humic DOC becomes less soluble at high salinities. Second, higher enrichments at high salinities may simply reflect an aging phenomenon. Third, this may be evidence of different partition coefficients for the two different sources of phenols. The surface microlayer may be temporary sink and a reaction site leading to the resolubilization of strongly UV-absorbing molecules in bulk water or their removal to the atmosphere. (Baker-FRC)
W82-03749

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

HYGIENIC EVALUATION OF THE POLYAMIDE MEMBRANE PHEYLONE-2S AND PHENOL FORMALDEHYDE RESIN VIAM-B FOR USE IN REVERSE OSMOSIS TREATMENT OF WATER. (GIGIENICHESKAYA OTSENKA POLIAMIDNYKH MEMBRAN FENILON-2S I FENOLFORMAL'DEGIDNOI SMOLY VIAM B, PRIMENENYAEMYKH PRI OBRATNOOSMOTICHESKOM OPRECHNENII VODY),
Institute of General and Municipal Hygiene, Moscow (USSR).
Yu Rakhmanin, T. A. Solokhina, R. V. Merkur'eva, and K. P. Ershova.
Gigiena i Sanitariia, No 10, p 19-22, October, 1981. 4 Tab, 7 Ref. (English Summary).

Descriptors: *Desalination, *Membranes, *Reverse osmosis, Water pollution effects, Polymers, Materials testing, Plastics, Resins, Evaluation, Water treatment, Drinking water, *Water treatment.

New polyamide membranes composed of phenylone-2s were evaluated for use in water supply systems. The membranes consisted of hollow fibers adhered together with phenol-formaldehyde resin VIAM-B. Under certain conditions, both the phenylone-2s and the phenol-formaldehyde resin may release harmful chemicals into the water, which adversely affect warm-blooded animals and water quality. Such adverse effects were not observed under industrial conditions typical of water desalination by reverse osmosis. In view of these findings both polymers are recommended for use in residential water supply systems.
W82-03698

SALT REMOVAL FROM BRACKISH WATER BY CONTINUOUS PROCESSES WITH AMPHOTERIC, THERMALLY REGENERABLE ION-EXCHANGE RESINS,
Delaware Univ., Newark. Dept. of Chemical Engineering.
T-B. Hsu.
PhD Thesis, June, 1981. 367 p, 95 Fig, 10 Tab, 144 Ref, 9 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-23816.

Descriptors: *Desalination, *Separation techniques, *Resins, *Ion exchange, Adsorption, Brackish water, Computer programs, Continuous flow, Thermal regeneration.

Two amphoteric, thermally regenerable ion-exchange resins, Amberlite XD-2 and Amberlite XD-5, have been utilized to remove salt from brackish water by continuous processes. The physical and chemical properties of both resins have been studied, including their resin capacity, density, poros-

ity, swelling phenomena, etc. The kinetic study of mass transfer in these resins has been carried out by means of frequency analysis during forced temperature cycling and also by fixed-bed breakthrough experiments. Amberlite XD-2 has a higher mass transfer rate than Amberlite XD-5. Both the results of theoretical simulation and the experimental results have been used for the evaluation of a 'Truly Countercurrent, Continuous Adsorption' process to remove salt from water. Amberlite XD-2 showed better separation performance than Amberlite XD-5 under the same operation conditions. The linear-equilibrium-line case, which may be important for dilute concentrations, was also simulated theoretically. The concept of a 'Quasi-countercurrent, Continuous Progressive-zone Adsorption' process has been proposed and studied from a theoretical viewpoint for cases with either linear or non-linear Langmuir equilibrium isotherms. A 'Continuous-flow, Stirred-Tank Reactor' theory and a 'Plug-flow, Fixed-bed Reactor' theory were derived to describe the behavior of this process. The more columns a ACPA process has, the closer it can approach the ideal of truly countercurrent operation. A 4-column QCPA process simulates truly countercurrent operation reasonably well. (Sinha-OEIS)
W82-03726

FROM SCREENING TO FILTRATION: TREATING THE WATER SUPPLY,
New Jersey Inst. of Tech., Newark.
H. S. Hundal, R. B. Trattner, and P. N. Cheremisinoff.
Water and Sewage Works, Vol 127, No 1, p 54-55, January, 1980. 9 Fig, 24 Ref.

Descriptors: *Seawater, *Desalination plants, *Reverse osmosis, Freezing, Electrodialysis, Costs.

Methods for obtaining freshwater from seawater are reviewed. Freezing can be used for this purpose because when water is frozen it forms crystals that are structurally free of salt. The salt remains on the surface of the crystal and can be washed off. There is not yet any fully satisfactory method of washing ice crystals, however. Electrodialysis utilizes electricity and ion-selective membranes to remove salt. This process has been used to treat brackish water, but its application to seawater is llmited by its high electricity requirements. Reverse osmosis has a low energy requirement and requires relatively simple equipment. About 95% of dissolved solids can be removed in a single unit, but two units would be required to make seawater potable. Fouling of the membrane by salt deposits can be a problem. Costs of desalination vary from about $0.60-$2/1000 gal. (Small-FRC)
W82-03739

3B. Water Yield Improvement

'NADIS', THE VITAL WATER RESOURCES OF THE INDIAN ARID ZONE,
Central Arid Zone Research Inst., Jodhpur (India).
K. D. Sharma, and D. C. Joshi.
Journal of Arid Environments, Vol 4, No 3, p 247-251, September, 1981. 2 Fig, 3 Tab, 1 Ref.

Descriptors: *Catchment basins, *Water supply development, *Construction methods, Design criteria, Nadis, *India, Arid lands, Soil types, Water management, Land management, *Water storage, Water resources, Water harvesting, Runoff, Storage reservoirs, Ponds.

One hundred nadis, ponds excavated in arid regions of India to capture and store precipitation for later use, were studied to provide a scientific basis and to suggest possible improvements in design and construction. At present villagers rely on their experience to select the best nadi sites. The physiographic settings of the five types of nadis in Nagaur district, West Rajasthan, were: dune complex (18 observations), sandy plain with deep soil (15), sandy plain underlain by concretion zone (21), younger alluvial plain (33), and rocky/gravel pediment (13). Their average depths were 2.2, 3.8, 6.0, 4.4, and 3.2 meters, respectively. Average volumes were (in thousands of cu meters): 23.5, 58.1, 192.1, 130.1, and 131.8, respectively. Catchment areas were 55.1, 94.3, 454.1, 313.7, and 300.1 hectares, respectively. Density was lowest in the dune complex (8 per 100 sq km) and highest in rock/gravel sediment (35 per 100 sq km). Average duration of use after filling was : 3.4, 3.8, 9.2, 11.3, and 9.9 months, respectively. Nadi volume was directly related to catchment area irrespective of surface, physiography, and rainfall. Highest nadi volumes were observed on dunes and sandy plains with slopes of 1-2%. It is recommended that nadis should be dug down to the CaC03 concretion zone in sandy soils. In dune and sandy areas, the catchment slope should be less than 2%, and in younger alluvial and rocky/gravel areas, greater than 2%. In dune areas nadi volumes are greater in the 300-350 mm rainfall zone than in higher rainfall areas. (Cassar-FRC)
W82-03413

A NOTE ON MINIMIZING TEMPERATURE RISE BY RESTRICTING EVAPORATION FROM SMALL OPEN WATER SURFACES,
Salford Univ. (England). Dept. of Civil Engineering.
B. Henderson-Sellers.
Water S A, Vol 7, No 2, p 71-75, April, 1981. 1 Fig, 4 Tab, 16 Ref.

Descriptors: *Evaporation control, *Water storage, *Water temperature, Lake evaporation, Reservoir evaporation, Evaporation, Temperature, Energy, Mathematical studies, Dissolved oxygen, Acid climates, Precipitation gages.

A theoretical analysis of the surface energy budget was performed to calculate the effect on water and temperature evaporation of using small, floating polystyrene spheres to cover open water surfaces. The temperature change was found to be related primarily to the reflectivity of the spheres and not to the percent coverage. Only total coverage will prevent evaporation, although if 0.8 of the surface is covered, there is an evaporation savings of 80%. Thus, for a large body of water, considerable savings in evaporative losses can be achieved together with a lowered water temperature even if the spheres are disturbed by, for example, the wind. In areas where there are water shortages, the cost of the covering material may be justified. When stored water is covered, there are higher concentrations of dissolved oxygen at saturation, unwanted plant growth is discouraged, and the water is more palatable. (Small-FRC)
W82-03440

RUNOFF PREDICTION AND RAINFALL UTILIZATION IN THE SEMI-ARID TROPICS,
Utah State Univ., Logan. Dept. of Engineering.
For primary bibliographic entry see Field 2A.
W82-03502

A CENTURY OF EFFORT QUENCHES HONG KONG'S THIRST,
Y. L. V. Sharma.
Aqua, No 6, p 19-23, 1981. 3 Fig, 1 Tab.

Descriptors: *Water supply, *Water resources development, Water demand, Population dynamics, China, *Hong Kong, Resources development, Drinking water, Reservoirs, Channels, Water conveyance, Catchment areas, Desalination.

Hong Kong survives even though it has always had an almost complete lack of natural resources. The water supply problem results from too many people and an inadequate catchment area. The present, efficient water supply system was built over 120 years of effort by the government in conjunction with international consultants and engineers. Since direct catchment areas are limited, extensive catchwaters are a vital feature of the waterworks development, and probably nowhere else in the world have they been so highly developed. Constructed around hillsides, the catchwaters collect water from areas where it would normally drain more or less directly to the sea or into valleys unsuitable for reservoirs. In more modern approaches water is collected from stream courses by means of intakes and shafts discharging into a main tunnel which carries the water to either an impounding reservoir or a treatment works. Hong Kong's water supply system also includes two reservoirs in the sea, 16 conventional reservoirs, one of the world's largest desalination plants, 14 treatment works, and a third of its total 1,060 square kilimeter area as catchment. While developing its own methods of securing water, Hong Kong also made agreements with China which ensure sufficient water supplies for Hong Kong, with an average annual increase in supply of about 35 million cubic meters beginning in 1983. China will be supplying 620 million cubic meters of water per year to Hong Kong by 1995. These close ties with China, constant readiness to develop any possible sources using modern technology, and the close monitoring of the overall water situation have enabled the government to assure its over 5 million inhabitants that reliable water supplies are available. (Baker-FRC)
W82-03743

3C. Use Of Water Of Impaired Quality

MANAGING VEGETATION IN WASTEWATER APPLICATION,
Michigan State Univ., East Lansing. Inst. of Water Research.
For primary bibliographic entry see Field 5D.
W82-03401

MANAGING SPRINKLE IRRIGATION WITH SALINE WATER FOR ZERO LEACHING,
Utah State Univ., Logan. Dept. of Engineering.
R. A. L. Brito.
PhD Thesis, 1980. 168 p, 22 Fig, 43 Tab, 49 Ref, 8 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-19236.

Descriptors: *Irrigation, *Sprinkler irrigation, *Saline water, *Leaching, Wastewater irrigation, Resources management, Water management, *Barley, Impaired water use.

A study was conducted with the objectives of (1) evaluating how long a salt-tolerant crop (barley) could resist a zero leaching situation where saline water was applied by irrigation, (2) comparing the effect of different salt composition of the irrigation water in increasing the EC of the soil solution, and (3) defining management strategies necessary to obtain a situation of no leaching under sprinkle irrigation. A greenhouse experiment was carried out that simulated a salt buildup which will take place in 13 years of continuous irrigation in the field for the soil types studied (silty loam and silty clay loam). Two types of irrigation water were used: one (W1) composed predominantly of sulfates and carbonates and the other (W2) composed primarily of chloride salts. The results pointed out that a zero leaching situation can be maintained with W1 and W2 for 13 or more years, for both soils. It was also found that W2 causes a faster increase in the EC of the irrigation water. Most of the results obtained at the end of the experiment agreed with predictions made by Robbin's model which was then used to determine an irrigation schedule that will allow for no leaching. Management strategies were proposed to eliminate deep percolation from a sprinkler source. Values of CU were estimated as the minimum required for different management according to the ratio of the average application to the lower limit of water application for the irrigated area. (Sinha-OEIS)
W82-03521

ENVIRONMENTAL EFFECTS OF APPLYING FEEDLOT RUNOFF TO GRASSLAND PLOTS BY SPRINKLER IRRIGATION,
Tennessee Univ., Knoxville.
N. Al-Masri.
PhD Thesis, March, 1980. 130 p, 23 Fig, 15 Tab, 55 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-18470.

Descriptors: *Feedlot runoff, *Sprinkler irrigation, *Water quality, *Environmental effects, Lagoons, Wastewater disposal, *Wastewater irrigation, Soil properties, Grasslands, Tennessee.

Irrigation of grassland with feedlot runoff appears to be a practical solution to the problem of disposal of such material. The major objectives of this study were: (1) to determine the effects on quality of surface water and groundwater of applying different rates of lagoon effluent on grassland plots, and (2) to determine effects on soil physical properties. A lagoon effluent irrigation system at the University of Tennessee-USDA Dairy Experiment Station at Lewisburg, Tennessee, served about 200 milk cows on a concrete lot from which runoff was collected into drains and delivered by gravity flow into a lagoon. The application of lagoon effluent to plots resulted in a high ammonia nitrogen concentration in surface runoff and groundwater from the plots which exceeded the maximum standard for raw surface water. The chemical oxygen demand concentration of the surface runoff and groundwater was much higher than that of nearby creek water. Factors existing at the time of lagoon effluent application which affected water quality parameters measured in surface runoff from the plots were: rainfall amount and intensities, soil moisture of the root zone, delay in time between lagoon effluent application and the occurrence of rainfall, and the rate at which lagoon effluent was applied to the plots. More reduction in the permeability and bulk density due to application of lagoon effluent occurred in the sandy loam soil than in the clay loam soil. The application of lagoon effluent with high solid fibrous material content caused more reduction in soil permeability and bulk density than lagoon effluent with low solid fibrous material content. (Sinha-OEIS)
W82-03528

CITY SEWAGE AND THE AMERICAN FARMER,
Carnegie-Mellon Univ., Pittsburgh, PA.
J. A. Tarr.
BioCycle, Vol 22, No 5, p 36-38, September/October, 1981.

Descriptors: *Land disposal, *Wastewater farming, *Farming, *Waste disposal, Land reclamation, Nutrients, Municipal wastewater, History, Wastewater irrigation, Public health, Costs, Irrigation, Fertilizers.

Land disposal of human wastes has been practiced for centuries in Europe and Asia. American farmers used wastes from cities for fertilizer during the 19th century. Sewage farming began in Great Britain about 1800 and in the U.S. about 1850, where it was called broad irrigation. In 1899 there were 24 municipal farms serving 280,000 people in New England and the West. Most of the subsequent development took place in the Southwest and Far West, where the prime motivation was irrigation. Although many publications extolled the merits of sewage farming, this process lost favor in the 20th century for 4 reasons: costs, public health and sanitary concerns, labor problems in the politically-run facilities, and large land requirements. Lessons to be learned from the past are: (1) all wastes require an ultimate sink, but sewage farming allows reclamation of vital nutrients, (2) cost accounting must be based on a system that considers long-term environmental impacts of sewage farming and its alternative disposal methods, (3) close monitoring is required to prevent health hazards and nuisances, and (4) sewage farming is most appropriate where sufficient land is available. (Cassar-FRC)
W82-03600

THE MEADOWBROOK ARTIFICIAL-RECHARGE PROJECT IN NASSAU COUNTY, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 4B.
W82-03630

HYDROLOGY AND MINING IN THE TUCSON AREAS,
Harshbarger and Associates, Tucson, AZ.
For primary bibliographic entry see Field 2F.
W82-03697

YIELD AND DEVELOPMENT OF SOYBEANS (GLYCINE MAX L.) AS AFFECTED BY IRRIGATION WITH MUNICIPAL WASTEWATER AND WELL WATER,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Science.
M. J. Cordonnier.
PhD Thesis, 1981. 98 p, 10 Fig, 16 Tab, 101 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-26486.

Descriptors: Irrigation, *Agriculture, *Wastewater irrigation, *Soybeans, Irrigation effects, Impaired water use, Municipal wastewater, Well water, *Crop yield, Michigan, Glycine max L.

The objectives of this study were to determine if soybean (Glycine max L.) yields in Michigan could be increased with supplemental irrigation and to investigate the feasibility of using secondarily treated municipal wastewater as the water source. The study was conducted on a Miami silt loam soil in 1979 and 1980. Each water treatment was split into eight subplots consisting of two soybean cultivars; three replications were used with either wastewater, well water, or no water assigned to the main plots. Seed yields were significantly different for water treatments in 1979 with 2434, 2580 and 2786 kg/ha for no water, well water, and wastewater, respectively. Yields generally increased as plant population increased, with the greatest yield recorded for both cultivars occurring at the highest plant population. Irrigated plants were taller, matured later, had larger seeds and lodged slightly more than nonirrigated plants. Results of this experiment indicate that Harcor responds much better than Nebsoy to additional water and to the spatial arrangement of plants. Harcor also appears to have a higher water requirement than Nebsoy. The 1980 growing season was wetter than normal, and there was little or no yield response to irrigation. The two cultivars responded differently to the wastewater, with Harcor exhibiting a positive response and Nebsoy responding negatively for such things as leaf area index, leaf weight, and stem weight. Under the conditions of soil, climate and wastewater quality during this experiment, wastewater was generally superior to well water in increasing yields. (Sinha-OEIS)
W82-03723

3D. Conservation In Domestic and Municipal Use

WATER METERING AND CONSERVATION,
Council of Economic Advisors, Washington, DC.
S. H. Hanke.
Water/Engineering and Management, Vol 128, No 10, p 57-59, 1981. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Water metering, *Cost-benefit analysis, Water measurement, Water conservation, Water use, *Perth, *Australia, Costs, Water costs, Economic aspects, Mathematical studies, Mathematical models.

To evaluate the benefits and costs of water metering, it is convenient to use a formal water conservation model. The objective of such a study is to maximize the net benefits from the adoption of any given strategy. This is accomplished by pursuing a conservation policy as long as its incremental benefits exceed its incremental costs. A demonstration of the usefulness of such a model can be achieved by evaluating the benefits and costs of a water meter installation program such as the one installed in Perth, Australia. During the period of 1976-77, 14% of the total water produced was used by 17,968 unmetered water connections. Commercial establishments and residences accounted for this unmetered use. Universal metering would have called for the installation of 17,968 water meters. An equation which would allow computation of benefits of such a program is discussed. Factors in this equation include the predicted reduction in consumption, the marginal cost of water, the change in benefits, the costs associated with universal metering, and the resource costs to consumers of metering. Given the original objective of maximizing net benefits and the decision rule, universal metering for Perth turned out to be an economically attractive conservation policy. (Baker-FRC)
W82-03562

3F. Conservation In Agriculture

TRAINING PROGRAMMES FOR BETTER WATER MANAGEMENT IN SURFACE IRRIGATION PROJECTS IN INDIA,
Mahi-Kadana Irrigation Project, Ahmedabad (India).
For primary bibliographic entry see Field 9B.
W82-03434

IRRIGATION, CROP YIELD AND DRAINAGE ON THE VAALHARTS IRRIGATION SCHEME: 1. THE CONTRIBUTION OF FARM WATER USAGE, IRRIGATION MANAGEMENT AND LEAKAGE FROM THE CANAL SYSTEM TO WATERLOGGING. (BESPROEIING, GEWASOPBRENGS EN DREINERING OP DIE VAALHARTS-BESPROEIINGSKEMA: 1. DIE BYDRAE VAN PLAASWATERVERBRUIK, BESPROEIINGSBESTUUR EN KANAALWATERVERLIESE TOT VERSUIPING),
Navorsingsinstituut vir Grond en Besproeiing, Pretoria (South Africa).
A. Streutker.
Water SA, Vol 7, No 2, p 97-106, April, 1981. 5 Fig, 7 Tab, 6 Ref.

Descriptors: *Irrigation efficiency, *Irrigation programs, *Water logging, Irrigation practices, Irrigation, Groundwater level, Canal seepage, Crop yield, *South Africa.

To improve irrigation efficiency and reduce leaching losses of fertilizers, water usage, irrigation management, and leakage from a canal system in South Africa were investigated. There had been complaints of waterlogging and salinization by users of the Vaalharts Government Water Scheme. Irrigation management was evaluated on flood irrigated beds with a GWT (groundwater table) at 1.4 to 2 m planted with groundnut. Over-irrigation was common, and leakage from the canals also contributed to waterlogging. Irrigation management contributed 42% of the waterlogging, while 10% was due to soil furrows and 5% to canal leakage. Farms with a deep GWT experienced more waterlogging than did farms with a relatively shallow GWT. Thus, irrigation management of the system could be improved with higher application rates for shorter periods. Subsurface drains would not be required to the extent that they are now, and larger areas could be irrigated during peak demand periods. (Small-FRC)
W82-03438

METHODOLOGY FOR OPTIMIZATION OF AN IRRIGATION SYSTEM WITH STORAGE RESERVOIRS,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
M. J. Khanjani.
PhD Thesis, August, 1980. 330 p, 25 Fig, 23 Tab, 216 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-08743.

Descriptors: *Irrigation design, *Irrigation requirements, *Water storage, *Storage reservoirs, Model studies, Economic aspects, Optimization.

A procedure was developed to specify optimal plans for an irrigation system with temporary internal storage. The procedure was used to develop plans for 1865 ha using farm service reservoirs. Daily potential and actual evapotranspiration for 25 years were computed. Probability distributions of potential and actual evapotranspiration for 1-30 days duration were estimated. A log-normal probability distribution was found to best fit the data, and probability equations for different durations were computed. These distributions were used to determine possible irrigation intervals for different crops growing in different soil types. A marginal cost and benefit analysis was used to select the best irrigation intervals for all soil-crop combinations.

Water-use information was used to compute the volume of interval storage needed within the system. By utilizing a mixed integer programming model, the locations of farm service reservoirs were optimized; and seven of the original 15 farm service reservoir sites were selected. A linear programming model was then used to compute the optimum capacity of each farm service reservoir, and parametric programming was used to examine the effects of varying water costs of system configuration. The cost and design capacity of the irrigation system with seven farm service reservoirs was computed. The total cost was 32% less than the cost of the irrigation system with the 15 original proposed farm service reservoirs. (Sinha-OEIS)
W82-03530

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

ASYNCHRONISM AND UNCORRELATED PHASES OF STREAMFLOW IN THE CASE OF ITS INTERBASIN TRANSFER WITH SPECIAL REFERENCE TO THE GEORGIAN SSR,
M. G. Babutsidze, B. A. Tutarashvili, and T. V. Shvelidze.
Water Resources (English Translation) Vol 7, No 6, p 524-527, November/December, 1980. 2 Ref. Translated from Vodnye Resursy, Vol 7, No 6, p 83-87, November-December, 1980.

Descriptors: *Diversion, *Diversion dams, *Hydroelectric power production, Rivers, Water level fluctuations, Seasonal variation, *USSR, Streamflow, Water transfer, Interbasin transfers.

Gravity flow diversion and diversion of water with pumping are analyzed from the point of view of asynchronism and uncorrelated phases of the streamflow. This study is related to the diversion of runoff from rivers of western Georgia (USSR) to eastern Transcaucasia. The delivery of part of the runoff from the Tskhenistskali River is analyzed as well as several proposed schemes. If the long-term fluctuations and annual distribution of the runoff of rivers coincide, then when water is diverted the amount of water in the basin receiving the runoff increases. When there is noncoincidence of long-term fluctuations, there is an increase in water and hydropower resources after diversion. Long-term asynchronism results in an increase in the minimum total volumes of annual runoff of individual rivers. (Small-FRC)
W82-03457

THE ECONOMICS OF URBAN STORMWATER MANAGEMENT,
Rice Univ., Houston, TX.
M. D. Maher.
PhD Thesis, May, 1980. 373 p, 39 Fig, 114 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-18068.

Descriptors: *Economic aspects, *Watershed management, *Storm runoff, *Urban runoff, Land use, Flooding, Cost-benefit analysis, Channeling, Runoff control.

Urban flooding and water quality problems are due to both natural phenomena and externalities related to urbanization. Development of upstream land increases the rate and amount of stormwater runoff from these areas. The consequences of increased upstream runoff are borne by downstream residents in the form of increased flooding and water pollution. It is shown that for a runoff control policy to be efficient; (1) because of irreversibility, runoff controls should be installed during a subdivision's construction. (2) The degree of a subdivision's detention of runoff should be based on the present value of damages that its runoff, in conjunction with other developments' runoff, will generate in the present and future. (3) The level of detention should reflect the location and timing of a development. Although runoff flows are irreversible, channelization can expand a stream's carrying capacity and reduce flooding without affecting runoff flows. The problems of the timing and sizing of irreversible upstream and downstream controls are explored in depth. It is shown that it is likely to be cost-effective to expand channel capacity to control some but not all future increases in runoff, some detention is likely to be efficient even in periods of excess channel capacity if in future periods runoff flows will increase to such an extent that irreversible 'congestion' of the channel will occur, and the probabilistic nature of rainfall and hence, runoff has significant policy implications. An important policy guideline is that watershed-wide stormwater management is necessary since uncoordinated community by community action cannot simultaneously implement runoff controls upstream and flood controls downstream. (Sinha-OEIS)
W82-03508

THE NILE - ONE RIVER AND NINE COUNTRIES,
High Aswan Dam Authority, Cairo (Egypt).
A-A. I. Kashef.
Journal of Hydrology, Vol 53, No 1-2, p 53-71, September, 1981. 2 Fig, 5 Tab, 19 Ref.

Descriptors: *Water resources development, *Water supply development, *Riparian rights, *Hydrologic budget, *Nile River, River basin development, Water reuse, Water requirements, Irrigation requirements, Water supply, Water management, Water demand, Water deficit, Africa.

The highlights of the water resource management efforts made on the Nile River by the nine countries through which the river flows are reviewed. At present, Egypt and Sudan practice modern methods of river control. Other countries drained by the Nile are planning to tap the water supply for expansion of irrigation projects. An estimated 96.57 cu kilometers of water/year will be needed to meet the water needs of the nine riparian countries, assuming that all proposed Nile projects are implemented. Water saving projects among the nations affected include developing groundwater supplies, building flood protection reservoirs, improving irrigation efficiencies by recycling, and utilizing the huge water supplies of Lake Albert and Lake Victoria. If these conservation projects are implemented and proper management authorities for Nile water resources are set up in the coriparian countries, no shortages should be expected in meeting the water demands of these African nations in the near future. (Geiger-FRC)
W82-03545

FILTER CRITERIA FOR SUB-SURFACE DRAINAGE,
For primary bibliographic entry see Field 8G.
W82-03660

EFFECTS OF A BARRAGE ON FLUSHING AND WATER QUALITY IN THE FITZROY RIVER ESTUARY, QUEENSLAND,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
D. W. Connell, B. M. Bycroft, G. J. Miller, and P. Lather.
Australian Journal of Marine and Freshwater Research, Vol 32, No 1, p 57-63, 1981. 3 Fig, 5 Ref.

Descriptors: *Tidal rivers, Barriers, Water quality, Dams, *Saline water barriers, *Water quality control, Ecological effects, Rivers, *Fitzroy River, Rockhampton, *Australia, Fate of pollutants, Stream discharge, Zero discharge, Estuaries, Flushing.

Construction of a salt water barrier 65 km from the mouth of the Fitzroy River, Australia, increased the residence time of water and pollutants in the lower estuary by decreasing the amount of fresh water flow. At high river discharges in February (2000 million cu meters per month) residence time is 0.2 months; at low discharges in November (100 million cu meters per month), 3.5 months. Comparisons of salinity data indicate that the barrage now retains more fresh water during low river discharges than before construction. It can be inferred that pre-barrage residence times were shorter than post-barrage residence times during dry months and similar during rainy months. Tidal exchange, producing a residence time of 8 months before and after barrage construction, is the principal flushing mechanism during low discharge periods. Water quality parameters are similar upstream and downstream of the barrage during high discharge. Dissolved oxygen reductions and nutrient and chlorophyll a concentration increases are observed downstream during low or zero discharge. (Cassar-FRC)
W82-03705

SAFE-YIELD ESTIMATES OF A WATER SUPPLY RESERVOIR ON AN UNGAGED STREAM,
Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 2E.
W82-03716

4B. Groundwater Management

SUBSIDENCE--A GEOLOGICAL PROBLEM WITH A POLITICAL SOLUTION.
Civil Enginering (New York), Vol 52, No 5, p 60-63, May, 1980. 2 Fig.

Descriptors: *Subsidence, *Groundwater management, Water management, Water demand, Groundwater mining, Water policy, Political aspects, Groundwater recharge, Flood damage, California, Texas, Population dynamics, Geological fractures, Sewer systems, *Overdraft.

Groundwater overdraft has produced land subsidence in 17 known areas in the U.S. The most serious property damage has occurred in California and Texas. Management approaches usually stress local control. The Harris-Galveston Coastal Subsidence District was created in 1974 to regulate groundwater withdrawl. Although the subsidence has stopped, damage is permanent, causing continued flooding, poor storm drainage, and activation of geologic faults. Santa Clara, California, stored storm water for recharging the aquifer from 1932 to 1960. When the demand for water stripped to supply in 1960, the water district began other preventive measures--water importation, recharging, and weather modification. The overdraft and subsidence was stopped by 1969, but $100 million in damages had occurred, including buckling of well casings, changes in sewer slopes, and flooding from San Francisco Bay. Although subsidence in the agricultural San Joaquin Valley, California, had been under control, a recent drought caused overdrafts that increased subsidence greatly. Comprehensive plans for groundwater management have been thwarted by agricultural interests, by lack of public concern, and by the needs of expanding populations. (Cassar-FRC)
W82-03452

IRRIGATION, CROP YIELD AND DRAINAGE ON THE VAALHARTS IRRIGATION SCHEME: 2. THE OCCURENCE OF AND THE INFLUENCE OF DRAINAGE ON SALINIZED SOIL (IN AFRIKAANS),
Navorsingsinstituut vir Grond en Besproeiing, Pretoria (South Africa).
A. Streutker, H. W. Molenaar, H. Hamman, C. C. Nel, and J. H. Mulder.
Water SA, Vol 7, No 3, p 175-184, July, 1981. 6 Fig, 4 Tab, 14 Ref. (English Summary).

Descriptors: *Flood irrigation, *Saline soils, *Waterlogging, Irrigation effects, Groundwater recharge, Environmental effects, Drainage systems, Crop yield, *South Africa.

The Vaalharts Irrigation SCheme was investigated for salinization, leaching of salts, and drainage system efficiency. The 30,000 ha have been flood irrigated since before 1940, and the shallow water table combined with sand soil has resulted in waterlogging and severe salinization. By 1976, almost

3,000 ha were saline or saline sodic to a depth of 0.3 m. Five hundred km of subsurface lateral drains (1.5-1.7 m deep) were added in 1975-1977 in an attempt to control the water table and promote the leaching of salts. These drains were successful in keeping the water table below 0.7 m and reducing salinization, but 1500 ha of saline soils remained in 1977 and about 1000 ha in 1980. A shallow drainage system might be able to retain beneficial groundwater supplies while counteracting the salinization of the soil. A system such as this would be accetpable if maintenance of the water table did not require considerable over-irrigation, resulting in river pollution. (Small-FRC)
W82-03466

GROUND WATER MONITORING: PART II,
For primary bibliographic entry see Field 8A.
W82-03484

GROUNDWATER ALLOCATION MECHANISMS: THE CASE OF WESTERN KANSAS,
Kansas Univ., Kansas City. Dept. of Economics.
D. R. Collins.
PhD Thesis, September, 1980. 118 p, 16 Fig, 2 Tab, 47 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-11728.

Descriptors: *Economic aspects, *Groundwater management, Property rights, Decision making, Administrative decisions, Resource allocation, *Water allocation, Water resources development, *Kansas.

The characterization of 'optimal' time paths for the development of groundwater resources within alter-native institutional settings is discussed. Optimality is defined in terms of the objectives of the agent or agents having authority to make decisions and carry out the associated actions relating to the use of the resource and does not imply superiority of one institutional setting relative to others. The institutional setting defines the decision-making authority of agents in the economy and any constraints which may be imposed by the social framework. Conditions relating to the supply of groundwater in western Kansas, economic incentives for its development, and the historical development in Kansas of a framework of property rights relating to groundwater are considered. Alternative institutional settings for groundwater development are formulated in the context of optimal control problems. The implications of operating costs for the comparison of groundwater allocation mechanisms is considered. The results of the study indicate that when decision-making authority is decentralized, the marginal conditions relating to groundwater allocation over time may differ from those selected under central control. It is indicated that significant differences in cost may be associated with operation of the allocation mechanisms under these alternative settings. The restrictions on the economic environment which are required for the groundwater resource allocation problem to be compatible with this method of analysis are outlined. (Sinha-OEIS)
W82-03503

HYDRODYNAMIC RESPONSE OF NAKHON LUANG AQUIFER, BANGKOK, THAILAND,
Asian Inst. of Tech. Bangkok (Thailand). Div. of Water Resources Engineering.
A. Das Gupta, and M. Siddique.
Ground Water, Vol 19, No 5, p 469-475, September/October, 1981. 9 Fig, 1 Tab, 7 Ref.

Descriptors: *Aquifers, *Hydrodynamics, Hydrology, *Thailand, Bangkok, Nakhon Luang Aquifer, Groundwater, Groundwater reservoirs, *Groundwater management, Aquifer characteristics, Water supply, Water demand.

A comprehensive study has been undertaken to maintain the water supply of the Nakhon Luang Aquifer in Bangkok. This paper outlines the existing situation and points out in quantitative terms the future implications of the present trend of pumpage and of some probably controlled pumpage foreseeable at this stage. The Chao Phraya Plain consists of a broad, deep basin filled with Sedimentary soil deposits which form alternating layers of sand, gravel and clay. In the upper 600 meters depth from the ground surface there are eight confined aquifers separated by virtually impervious strata of clay. The Nakhon Luang Aquifer is of prime importance, as it supplies the majority of the wells in the city of Bangkok at the present time. This aquifer consists of permeable sand and gravel with clay lenses and leaky clay beds, and yields excellent quality water except in the southern region and especially in the Phra Pradaeng area where salt water is encountered due to overpumping. In a simulation of the hydrodynamic behavior of this aquifer using information on hydrogeology and hydraulic aspects available, it was determined that with continuation at the present rate of increase in pumpage, a severe decline of piezometric head is predicted for the future. Active initiative is needed from the authorities concerned to increase the surface-water supply facility and to adopt certain control measures to restrict the private and industrial usage of ground water in the area. (Baker-FRC)
W82-03576

THE MEADOWBROOK ARTIFICIAL-RECHARGE PROJECT IN NASSAU COUNTY, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
D. A. Aronson, and M. Beyth.
Long Island Water Resources Bulletin 14, 1980. 23 p 10 Fig, 1 Tab, 33 Ref. Nassau County Department of Public Works.

Descriptors: *Artificial recharge, *Groundwater recharge, *Injection wells, *Reclaimed water, Ponding, Water reuse, Water management, New York, *Long Island, Nassau County, Suffolk County, Land application, Water supply, Wastewater treatment.

In Nassau and Suffolk Counties, where the quality and quantity of potable ground water have declined as a result of urbanization, the use of highly treated wastewater (reclaimed wastewater) to replenish the ground-water supply is technically feasible. Two methods that are particularly well suited to Long Island are surface ponding of the reclaimed water in basins so that it can infiltrate to the water table, and injecting the reclaimed water into the ground through wells. At the Meadowbrook artificial-recharge project site in East Meadow, a system of 11 basins and 5 injection wells will return to the ground-water reservoir 4 million gallons per day of reclaimed wastewater, supplied by the Cedar Creek water-reclamation facilities. This demonstration project is intended to study the effectiveness of using reclaimed wastewater to replenish and improve the chemical quality of Long Island's round-water supply. Knowledge gained in the study will have applicability to other areas where the need to conserve and augment fresh-water supplies has become critical. (USGS)
W82-03630

THE OCCURRENCE AND CONTROL OF LAND SUBSIDENCE DUE TO GROUNDWATER WITHDRAWAL WITH SPECIAL REFERENCE TO THE SAN JOAQUIN AND SANTA CLARA VALLEYS, CALIFORNIA,
Stanford Univ., CA. Dept. of Geology.
J. F. Poland.
PhD Thesis, June, 1981. 176 p, 44 Fig, 5 Tab, 120 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-24135.

Descriptors: *Groundwater depletion, *Subsidence, *Compaction, Groundwater recharge, Groundwater basins, Aquifers, Aquitards, Elastic properties, Aquifer characteristics, *Groundwater management, Injection wells, San Joaquin Valley, Santa Clara Valley, *California, Repressuring, Subsidence control.

The San Joaquin Valley in California is the area of the most intensive land subsidence in the United States. In the Santa Clara Valley at the south end of San Francisco Bay, excessive pumping of ground water between 1917 and 1967 caused as much as 180 ft (50 m) of artesian-head decline and maximum land subsidence of 13 ft (4 m). Wilmington oil field, in the harbor area of Los Angeles and Long Beach, California, is not only the oil field of maximum subsidence in the United States but also the outstanding example of subsidence control by injection and repressuring. Both direct and indirect evidence is accumulating to indicate that, under the total stresses applied to unconsolidated heterogeneous deposits in overdrawn ground-water basins, most of the compaction of the aquifer systems is in the fine-grained aquitards and little is in the coarse-grained aquifers. In a confined system that is compacting because of decrease in fluid pressure, compaction and subsidence can be stopped by raising fluid pressures in the aquifers sufficiently to eliminate excess pore pressure in the aquitards and confining beds (clays or shales). Moreover, the system (both aquifers and aquitards) will expand elastically and the land surface will rise if fluid pressures are increased above preconsolidation conditions. In liquid-waste disposal also, the response of the sediments normally would be in the elastic range. (Sinha-OEIS)
W82-03714

NEW LEGISLATION IN CALIFORNIA AND ITS EFFECTS,
For primary bibliographic entry see Field 6E.
W82-03731

AN ECONOMIC APPROACH TO GROUND WATER QUALITY MANAGEMENT,
California Univ., Davis. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 5G.
W82-03732

MODELING THE ECONOMICS OF GROUND WATER MANAGEMENT,
Auslam and Associates, Inc., Sacramento, CA.
J. E. Noel.
In: Proceedings of the Thirteenth Biennial Conference on Ground Water, Irvine, September 14-15, 1981. California Water Resources Center, University of California, Davis, Report No 52, November, 1981. p 92-102. 3 Fig, 2 Tab.

Descriptors: *Groundwater management, Mathematical models, Hydrologic models, Water resources development, Simulation analysis, Value, Surface water, Mathematical studies, Hydrologic data collections, Water balance equation, Water costs, *Economic aspects, *Irrigation, *Crop production, *Model studies.

A hydrologic-economic modeling framework can be a valuable tool when used to evaluate the economic consequences of different groundwater and surface water management scenarios. There are two operational problems associated with developing a hydrologic-economic model of groundwater management: estimating the different economic and hydrologic relationships that make up these components of the problem, and interrelating the economic and hydrologic elements so that each provides information to the other in a continuous and consistent manner. Four mathematical models--two hydrologic, one economic, and one with hydrologic and economic elements--are discussed that make up the San Joaquin Valley Hydrologic-Economic Modeling system (HEM). One hydrologic model is the surface water allocation model (SWAM) which computes a mass water balance (inflows, losses, outflows) so that supply equals demand at every conveyance facility in the Valley's surface supply network. The other hydrologic model is a layered two-dimensional saturated flow groundwater model which can simulate unconfined flow in the top layer of the groundwater basin and confined flow in the bottom layer. The economic non-linear programming model can determine optimal changes in farm income, cropping patterns, irrigation technologies, and land use given changes in crop demand, crop production costs, and water management scenarios. The final model in the HEM system is the Linear Quadratic Control Model: it is a policy model from which optimal pumpage and groundwater depths can be

determined over a specific period under different water management scenarios. (Atkins-Omniplan)
W82-03733

MANAGING WELLS FOR ENERGY EFFICIENCY,
California Univ., Davis. Dept. of Civil Engineering.
O. Helweg.
In: Proceedings of the Thirteenth Biennial Conference on Ground Water, Irvine, September 14-15, 1981. California Water Resources Center, University of California, Davis, Report No 53, November, 1981. p 119-127. 8 Fig, 4 Ref.

Descriptors: *Wells, *Well yield, *Pump wells, *Optimal yield, Pumping head, Head loss, Discharge capacity, Effective capacity, Benefits, *Groundwater management, Energy efficiency.

Saving energy is advantageous from an economic as well as an ecological viewpoint. When water well yield deteriorates or when the optimal discharge of a pump decreases either or both should be replaced or repaired. A wire-to-water test is used to evaluate electrical driven pumps. Loss in pump efficiency should be measured over time to establish a trend. The results then need to be normalized, i.e., compared to maximum efficiency at the same discharge and head. Correcting pumping inefficiences involves: (1) when to correct the inefficiency, and (2) what the correction should be, i.e., repair or replacement. In economic terms, pump replacement is recommended when the marginal net benefits of the defender equal the maximum amortized net benefits of the challenger. Several tables show how these calculations are made. A similar analysis is made, and a formula given, to determine when to rehabilitate a well. Simply, a well should be rehabilitated when the maximum annualized net benefits of rehabilitation are greater than the old annual (marginal) net benefits. If a well is not affected by rehabilitation, replacement analysis is needed; however, some wells deteriorate so slowly that pumping costs do not increase and the economic life of the well is infinite. Other factors hold in general for wells: pumping costs are usually higher than well construction costs; replacement analysis for municipalities is simpler because there is no tax, whereas a private owner must consider the impact of taxes and depreciation; and the most economical design should be chosen over the cheapest when drilling a new well so as to save future energy. (Atkins-Omniplan)
W82-03734

SB 1391--TOWARDS A PERMIT SYSTEM FOR GROUND WATER. TOWARDS A NEW DEFINITION OF OWNERSHIP OF GROUND WATER,
For primary bibliographic entry see Field 6E.
W82-03736

ARTIFICIAL BASIN RECHARGE,
Water Management Research Laboratory, Fresno, California.
H. L. Nightingale, and W. C. Bianchi.
Water/Engineering and Management, Vol REF, No HB, p R85-87, R89-92, 1981. 4 Fig, 84 Ref.

Descriptors: *Recharge basins, *Artificial recharge, *Planning, Basins, Recharge, Groundwater, Soil profiles, Geology, Surveys, Productivity, *Groundwater management.

Basin-type artificial recharge and preconstruction field surveys are discussed. These surveys are made to evaluate the magnitude of potential problems as related to both a project's recharge rate and its environmental impact. A multidisciplinary approach is needed to plan and operate a successful recharge facility. Assuming that the size of the groundwater basin and amount of storage capacity available are amenable to recharge, seven phases have been identified, in order of priority: precursory site evaluation, soil profile and subsurface geology determinations, recharge water quality determinations, biological considerations, pilot test basin study, construction plants, and the operation, maintenance and performance evaluation plans. In most reports of failures of basin recharge facilities and small experimental sites, soil clogging is to blame. This clogging is caused by sediment in the recharge water. The reason for sediment formation is not always clearly apparent. Sediments can be generated by improper construction techniques. Soil compaction from heavy construction equipment rarely seems to be at fault. The chances of long-term economical basin recharge can be improved by superimposing on the purely engineering aspects of construction and operation the principles of soil chemistry, hydrology, water chemistry, aquatic biology and subsurface geology. Interaction between engineering and environmental factors must be carefully considered to increase the chances for valid decisionmaking and planning which will produce a successful basin recharge facility. (Baker-FRC)
W82-03745

4C. Effects On Water Of Man's Non-Water Activities

INTERSTATE HIGHWAYS VERSUS WATERSHED PROTECTION IN NEW ENGLAND,
Jordan (Perkins), Inc., Reading, MA.
For primary bibliographic entry see Field 5B.
W82-03431

WILL THE WORLD FACE UP TO ITS EVER-WORSENING ENVIRONMENTAL PROBLEMS.
Civil Engineering (New York), Vol 50, No 9, p 71-74, September, 1980.

Descriptors: *Environmental effects, *Soil erosion, *Forest management, Erosion, Acid rain, Deserts, Saline soils, Water quality, Irrigation water, Water pollution effects.

Among the world's most pressing environmental problems are soil deterioration (erosion and salinity buildup), atmospheric changes (including acid rain), and accelerating extinction of plant and animal species (deforestation and wetlands destruction). Results of soil erosion are siltation of rivers and reservoirs, impaired water quality, and a return of agricultural land to desert. Salt buildup in farmed areas is serious both in poorer countries such as India and Pakistan and in the San Joaquin Valley, California. This condition can be alleviated and prevented by using enough irrigation water to flush out the accumulated salts. However, downstream farmers are then faced with higher salt levels in their irrigation water. Acid rain, formed from burning of sulfur-containing fuels, also damages soil. This is now a problem in the eastern and southwestern U.S., northern and eastern Europe, and parts of the Soviet Union and Australia. Deforestation, especially in the tropics, destroys the land's ability to store water, producing rapid runoff during rainfall, intensified flooding, and water shortages during dry spells. (Cassar-FRC)
W82-03459

THE ECONOMICS OF URBAN STORMWATER MANAGEMENT,
Rice Univ., Houston, TX.
For primary bibliographic entry see Field 4A.
W82-03508

TEMPORARY HYDROLOGIC CHANGES AFTER DEFORESTATION FOR PIONEER HOMESTEADING,
H. Ryckborst.
Journal of Hydrology, Vol 53, No 1-2, p 117-133, September, 1981. 10 Fig, 1 Tab, 11 Ref.

Descriptors: *Clear-cutting, Snowmelt, *Geohydrology, *Soil porosity, *Groundwater level, Forest hydrology, Forest soils, Groundwater runoff, Sublimation, Soil profiles, *Groundwater recharge, Evaporation, Radioactive tracers, *Water level fluctuations, *Alberta, Canada.

Modern homestead lands in Central Alberta, Canada that have been cleared of forest and brush experience a temporary disturbance in soil profile and a slight increase in effective porosity of groundwater recharge areas. An 8-year experiment on the impact of deforestation on the hydrology of a research catchment of the homestead lands using radioactive tracers showed that these impacts should be only minor and temporary. In the recharge areas, deforestation caused the groundwater table to drop by 0.2-0.5 m with an average two year recovery period. In the remaining groundwater discharge areas, groundwater table levels rose due to decreases in the effective porosity caused by mechanized deforestation. The main impacts of homesteading deforestation are a slight increase in total snowmelt runoff from 60 to 75 millimeters/year, a shortening of the snowmelt period from 5 to 4 weeks, an increase in snowmelt groundwater runoff from 1.0 to 1.9 millimeters/day and a decrease in snow-cover sublimation and evaporation by 40%. (Geiger-FRC)
W82-03544

EFFECT OF FELLING FORESTS ON FLOOD RUNOFF IN THE CARPATHIAN MOUNTAINS WITH SPECIAL REFERENCE TO BEECH FORESTS,
O. V. Chubatyi.
Water Resources, Vol 8, No 1, p 13-18, January/February, 1981. 5 Tab, 1 Ref. Translated from Vodnye Resursy, No 1, p 48-55, January/February, 1981.

Descriptors: *Logging, *Runoff coefficient, *Clear-cutting, Snowmelt, Precipitation, *Flood discharge, Forest watersheds, Forest management, *Carpathian Mountains, *USSR, Infiltration, Rainfall-runoff relationships, *Forest soils.

Infiltration into forest soils was studied in 3 forested watersheds in the Transcarpathian Mountains, U.S.S.R., a region of high precipitation frequency. After a 5-year calibration period, the first basin was clear-cut; the second, 2-step felled (30% cutting followed by the remainder of the timber cut 8 years later); and the third acted as a control. During the calibration period flood runoff coefficients increased with increasing values of effective precipitation and were similar in the 3 basins (0.03-0.39). After clear-cutting in Basin I and the first stage of cutting in Basin II the coefficients were 0.02-0.91 and 0.02-0.68, respectively. In the 2-year period after the second (final) step of cutting in Basin II, the flood runoff coefficients were: I, 0.05-0.89; II, 0.13-0.71; and III (control), 0.03-0.30. Maximum flood runoff coefficients were seen after melting of snow. When summer cloudbursts overlapped, runoff coefficients increased progressively. The ratio of runoff coefficients for Basin I:Basin III and Basin II:Basin III were higher for the first year after felling than for the fourth year after felling. (Cassar-FRC)
W82-03574

4D. Watershed Protection

SEDIMENTATION CONTROL IN INDIAN RESERVOIRS,
Edinburgh Univ. (Scotland).
For primary bibliographic entry see Field 8A.
W82-03693

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

MINERAL ELEMENT CONTENT IN ULVA LACTUCA L. WITH REFERENCE TO EUTROPHICATION IN HONG KONG COASTAL WATERS,
Hong Kong Univ., Dept. of Botany.
For primary bibliographic entry see Field 5B.
W82-03417

AN ORGANICS DETECTION SYSTEM FOR THE OHIO RIVER,
Ohio River Valley Water Sanitation Commission, Cincinnati.
L. Weaver, R. Boes, and G. Moore.
Water Science and Technology, Vol 13, No 3, p 227-236, 1981. 3 Fig, 2 Tab.

Descriptors: *Water quality control, *Monitoring, *Chlorinated hydrocarbons, Water pollution control, Pollutant identification, *Ohio River, Organic compounds, Water analysis, Rivers, Chemical analysis, Carbon tetrachloride, Chloroform, Trihalomethanes, Industrial wastes, Heavy metals, Polychlorinated biphenyls, Sediments, Fish, Pesticides, Industrial spills.

In 1977 the Ohio River Valley Water Sanitation Commission established the Early Warning Organics Detection System to detect organic pollutants in river water after the well-publicized spill of carbon tetrachloride into the Kanawha River, a major Ohio tributary. Local water treatment plants or industrial plants provide laboratory space and personnel for the Commission's gas chromatographic equipment. If any of the daily samples indicate organics levels significantly above the background level, the EPA confirms the analysis with more sophisticated analytical equipment, and downstream water users are promptly notified of the pollutant load. Equipment costs for the program were $300,000, and annual operating costs are $20,000-$25,000. In addition, fish diversity studies and analysis of fish tissue and sediments are conducted. Fish populations have improved in production, diversity, and stability since the 1957-60 baseline study. During the last 9 months of 1979 most of the total 1350 samples contained less than 0.1 micrograms per liter of the 19 purgeable halocarbons under consideration. Compounds found in the amounts greater than 10 micrograms per liter were chloroform, methylene chloride, bromodichloromethane, chlorobenzene, and carbon tetrachloride. Chloroform is found in 70% of the Ohio River samples and 13% of the tributary samples. Chlorobenzene appears primarily in the main river; carbon tetrachloride seems to originate in the Kanawha River. The monitoring program has proved to be an effective safeguard of downstream water supplies, and aid in identifying pollution sources, and a deterrent to potential polluters. (Cassar-FRC)
W82-03436

HIGH PERFORMANCE LIQUID CHROMATOGRAPHIC DETERMINATION OF CARBARYL AND 1-NAPHTHOL AT RESIDUE LEVELS IN VARIOUS WATER SOURCES BY DIRECT INJECTION AND TRACE ENRICHMENT,
Maine Univ., at Orono. Dept. of Food Science.
R. J. Bushway.
Journal of Chromatography, No 211, p 135-143, June, 1981. 3 Fig, 3 Tab, 50 Ref.

Descriptors: *Carbaryl, *Water analysis, *Pesticide residues, Pollutant identification, Insecticides, Herbicides, Chromatography, Naphthol, Organic compounds, Carbamate pesticides.

Carbaryl and its hydrolysis product, 1-naphthol, at low ppb concentrations in water were determined by a high-performance liquid chromatographic method. Water samples were filtered through a 0.45 micrometer Millipore filter and injected directly into the chromatograph system, which used a variable wavelength UV detector reading at 222 nm. No cleanup, concentration, or derivatization were required. Levels less than 1 ppb were determined by first concentrating the sample with an activated C18 Sep-Pak cartridge using a fluid metering pump. Samples of ocean water, stream water, and drinking water were spiked with carbaryl and 1-naphthol at concentrations from 3.78 to 207 ppb. Coefficients of variation ranged from 2.5 to 10.7%. Different types of water with equal amounts of carbaryl did not produce the same peak height; therefore, a working standard should be made up daily with water as near as possible in composition to the sample being analyzed. Other pesticides successfully detected with this system were carbofuran, methomyl, azinphosmethyl, benomyl, monuron, propham, chloropropham, pentachlorophenol, the oxygen analog of azinphosmethyl, and simazine. Atrazine co-chromatographed with carbaryl, and pentachloronitrobenzene, diuron and thiram interfered with the 1-naphthol determination. (Cassar-FRC)
W82-03444

ENUMERATING BACTERIA IN RIVER WATER AND SEWAGE EFFLUENT,
Western Kentucky Univ., Bowling Green. Dept. of Biology.
L. P. Elliott.
Water/Engineering and Management, Vol REF, No HB, p R122-R123, 1981. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Sewage bacteria, *Assay, Bacteria, Rivers, Chlorination, Bacterial analysis, Water quality, River water, Path of pollutants, Wastewater treatment.

A technique is reported for enumerating bacteria in river water and sewage effluent in which the medium was spread-inoculated with calibrated loops delivering 0.01 or 0.001 ml. The results were compared with the standard spread plate-count technique for the enumeration of baceria in river water. The spread plate technique was used inasmuch as there was no reduced growth rate of obligate aerobes and no danger of killing heat sensitive organisms with hot-agar. Five sampling sites were chosen about 1/4 mile apart in the Barren River flowing through Bowling Green, Kentucky. One site was upstream from the sewage disposal plant, another was in the effluent from the plant's discharge pipe, and three were downstream from the discharge outlet. Sampling was done from a boat at midstream, with samples taken semimonthly during March 1978 through February 1979. In a comparison of the standard usual spread plate method versus the plate loop method, the two methods were not significantly different. Sometimes the effluent count was lower than the counts from other sampling stations. The wastewater treatment plant provides primary and secondary treatment by means of an activated biological filter system which is a combination activated sludge and trickle-filter process. All effluent is chlorinated by automated chlorinators. It was concluded that calibrated loops which deliver 0.01 and 0.001 ml, when used as described in this paper, provided a simple, rapid, reliable means of inoculating agar media for estimating populations of bateria in water. (Baker-FRC)
W82-03446

IDENTIFICATION AND DETERMINATION OF AMINOCARB IN NATURAL WATER AND BALSAM FIR FOLIAGE. (RECHERCHE ET DOSAGE DE L'AMINOCARB DANS LES EAUX NATURELLES ET LE FEUILLAGE DU SAPIN BAUMIER PAR CHROMATOGRAPHIE EN PHASE GAZEUSE),
Service de Protection de l'Environnement, Sainte-Foy (Quebec).
G. Mamarbachi.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 3, p 415-422, 1980. 1 Tab, 4 Fig, 10 Ref. (English Summary).

Descriptors: *Pesticides, Agricultural chemicals, *Forestry, *Agricultural hydrology, Environmental effects, Surface waters, Gas chromatography, Vegetation, Vegetation effects, Chemical analysis, Chloroform, Water pollution, Chemical properties, Reagents, Degradation products, Fir trees, Leaves, *Pollutant identification, *Aminocarb.

A method for the determination residues of the insecticide aminocarb in natural waters and balsam fir foliage is described. Average recoveries of more than 90% from foliage and nearly 100% from water can be achieved. The insecticide is extracted from water with chloroform and from foliage with ethyl acetate. The extracts are purified by coagulation with an aqueous solution of ammonium chloride and phosphoric acid. The solution is partitioned with methylene chloride, neutralized with sodium carbonate and then extracted with chloroform. The extract is then concentrated and injected directly into a gas chromatograph equipped with a dual nitrogen-phosphorus detector. (Titus-FRC)
W82-03460

STUDIES OF THE TRANSFORMATIONS OF FORMS OF CARBON, NITROGEN, PHOSPHORUS, SULFUR AND SOME PRINCIPAL MINERAL ELEMENTS DURING THE MEASUREMENT OF THE TOTAL OXYGEN DEMAND - II. TRANSFORMATION OF FORMS OF NITROGEN (IN FRENCH),
Institut National des Sciences Appliquees, Toulouse (France). Lab. de Chimie et Genie de l'Environnement.
B. Capdeville, C. Laffont, and H. Roques.
Water Research, Vol 14, No 5, p 501-509, May, 1980. 12 Fig, 2 Tab, 13 Ref. (English Summary).

Descriptors: *Oxygen demand, *Analytical techniques, *Chemical interferences, Nitrogen compounds, Inorganic compounds, Amino acids, Model studies, Oxidation, Laboratory equipment.

The oxidizability of organic compounds containing nitrogen was studied along with the interferences due to the presence of ammonium, nitrous and nitric nitrogen ions in the water. At a total oxygen demand of 0-250 mg/l the organic and ammonium nitrogen are partially oxidized and transformed into a mixture of N2 and NO. This illustrates the advantage of the TOD (total oxygen demand) meter compared with classic COD and BOD5 oxidation tests, where these elements are rarely taken into account and these forms are oxidized incompletely. Nitrous and nitric nitrogen create important negative interferences, but they can be corrected for by a simple proposed tabular method. Measurements were made using TOD meter to distinguish the stable forms of organic and inorganic nitrogen after high temperature catalytic action. (DL) citrulline, (DL) aspartic acid, creatinine, (L+) glutamine, (DL) threonine, (L-) asparagine, beta-alanine, (L+) arginine and (DL) serine were used as model organic nitrogen compounds. (Hertzoff-FRC)
W82-03485

STUDIES OF THE TRANSFORMATION OF CARBON, NITROGEN, PHOSPHORUS, SULPHUR AND THE PRINCIPAL MINERAL ELEMENTS IN THE COURSE OF MEASURING TOTAL OXYGEN DEMAND--III. TRANSFORMATION OF SULFUR (IN FRENCH),
Institut National des Sciences Appliquees, Toulouse (France). Lab. de Chimie et Genie de l'Environnement.
C. Laffont, B. Capdeville, and H. Roques.
Water Research, Vol 15, No 5, p 561-572, 1981. 8 Fig, 1 Tab, 7 Ref. (English Summary).

Descriptors: *Oxygen demand, *Sulfur compounds, *Wastewater analysis, Pollutant identification, Chemical analysis, Chemical oxygen demand, Seawater, Sulfate, Sulfite, Sulfides, Organic compounds, Chemical reactions, Chemical interference.

Interferences with measuring oxygen demand using the Dow Chemical Ionics 225 TOD (total oxygen demand) meter and the COD method were determined in waters containing inorganic salts (such as industrial wastewaters and seawater). Sulfur-containing organic compounds of the type CxHyOxS were partially oxidized to SO2 and SO3 in a consistent manner in the TOD test and variably in the COD test. Sulfate and sulfite ions were negatively correlated with TOD, and sulfide was positively correlated. Corrective equations were developed to account for these interferences. The TOD test was better than COD for determining organic pollutants in the presence of inorganic salts. (Cassar-FRC)
W82-03486

STUDY OF THE TRANSFER OF CD, PB, CU AND ZN IN NERITIC AND ESTUARINE TROPHIC CHAINS - II. BIOLOGICAL ACCUMULATION IN PLANKTONOPHAGE FISH. (ETUDE DU TRANSFERT DE CD, PB, CU ET ZN DANS LES CHAINES TROPHIQUES NERI-

TIQUES ET ESTUARIENNES-II. ACCUMULATION BIOLOGIQUE CHEZ LES POISSONS PLANCTONOPHAGES),
Institut des Sciences de la Nature, Nantes (France). Lab. d'Ecologie Animale et Biologie Marine; and Nantes Univ. (France). Lab. de Biologie Marine.
For primary bibliographic entry see Field 2L.
W82-03491

CARBON ISOTOPE ANALYSIS OF CARBONACEOUS COMPOUNDS IN PUGET SOUND AND LAKE WASHINGTON,
Washington Univ., Seattle.
J. R. Swanson.
PhD Thesis, August, 1980. 230 p, 34 Fig, 14 Tab, 358 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-09776.

Descriptors: *Biochemistry, *Carbon radioisotopes, *Water pollution, Organic matter, Sediments, Aromatic hydrocarbons, Aliphatic hydrocarbons, Water pollution sources, *Puget Sound, *Lake Washington, Carbonaceous compounds, Biogeochemistry, Carbon Isotope Analysis.

A new method has been developed and tested for determining chronological profiles of organic pollutants. This method, Carbon Isotope Analysis (CIA), involves measurement of 12C, 13C and 14C in carbonaceous compounds found in layers of sediment. Lipids, total aliphatic hydrocarbons (TAHs) and polycyclic aromatic hydrocarbons (PAHs) are separated from kg quantities of sediment. The basic principle of Carbon Isotope Analysis is the fact that natural isotopic differences present in organic compounds are due to their respective sources. Carbon Isotope Analysis uses three levels of 14C in organic compounds to develop a chronological profile of the anthropogenic impact on sedimentary organic compounds. The overall impact of organic pollutants on a given region often cannot be determined by compound identification alone. Most sophisticated analytical instruments often confuse compounds derived from petroleum and coal dust with natural organic degradation products. By using Carbon Isotope Analysis, additional insight to pollution can be obtained and the impact of chronic levels of toxicants can be identified This investigation reviewed carbon isotopic data and carbon cycling and analyzes organic pollution in two limited ecosystems (Puget Sound and Lake Washington).
W82-03505

SPECIATION OF ENVIRONMENTAL POLLUTANTS BY GC-AA AND BY ESCA. PURIFICATION OF WATER AT ULTRATRACE LEVELS OF HEAVY METALS AND COMPLEXATION STUDIES BY ELECTROCHEMICAL METHODS,
Louisiana State Univ., Baton Rouge. Dept. of Chemistry.
I. A-L. Rhodes.
PhD Thesis, May, 1980. 347 p, 91 Fig, 24 Tab, 225 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-21759.

Descriptors: *Pollutant identification, *Heavy metals, *Water pollution, *Lead, *Speciation, Electrochemistry, Gas chromatography, Spectral analysis, Bibliographies, Air pollution, *Tetraethyl lead(TET), Environmental pollution, Airborne pollutants, Comlexation.

A GC-AA method was developed that allowed the simultaneous determination of PbEt4 and of PbEt3Cl in gaseous and liquid sampled. This method enabled the study of the behavior of PbEt4 (TEL) and the formation of PbEt3Cl in sea water under several experimental conditions. From the results obtained, the potential hazard of TEL spills at sea was evaluated as well as the effect of particulate materials present in sea water on TEL concentration levels. Airborne heavy metal pollutants were studied by ESCA and the final chemical form of airborne Pb was found to be PbO2. The importance of ESCA as a valuable tool for speciation of airborne matter was demonstrated. An electrochemical method was developed to produce a readily available and economic source of ultrapure water. A method was developed for the determination of stability constants of heavy metal complexes and for the study of reaction kinetics of complex formation. The electrochemical technique was illustrated with Cd, Pb and Zn complexes of EDTA. Problems in storing very pure water and very dilute solutions of metal compounds are also discussed. An essentially complete literature review of each subject discussed is included. (Sinha-OEIS)
W82-03526

THE CHARACTERIZATION AND ANALYSIS OF CHLORINATED ORGANIC COMPOUNDS DERIVED FROM CHLORINATION OF HUMIC SUBSTANCES IN SURFACE WATERS,
Massachusetts Univ., Amhurst. Dept. of Chemistry.
B. D. Quimby.
PhD Thesis, September, 1980. 199 p, 35 Fig, 5 Tab, 79 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-01385.

Descriptors: *Pollutant identification, *Chemical analysis, *Organic compounds, *Surface water, Chlorination, Drinking water, Phenols, Fulvic acids, Humic acids, Gas chromatography, Trihalomethanes, Microwave emission detection(MED).

Suitable strategies were developed for characterizing the halogenation products of humic materials, both the trihalomethanes and other expected products. To provide element selective detection for gas chromatographic studies, a microwave emission detection system (MED) was developed utilizing an echelle grating spectrometer and a TM sub 010 resonant microwave cavity to sustain a plasma in helium at atmospheric pressure. The MED system was applied to the determination of the trihalomethanes in drinking water. Glass capillary gas chromatography was used in conjunction with the MED system to examine the chlorination products of humic and fulvic acids. The results indicate that in addition to the trihalomethanes, significant numbers of chlorinated phenolic and/or acidic compounds can be formed. The presence of bromide ion in the chlorination mixture was shown to result in bromine-containing compounds as well. Since many of these compounds cannot be gas chromatographed directly, chemical derivatization with diazomethane was employed. The number of halogen-containing substances that appear in the element-selective chromatograms was greatly increased after methylation of the samples. Several halogenated phenols and aromatic carboxylic acids have thus far been tentatively identified by retention times. (Sinha-OEIS)
W82-03529

BALANUS EBURNEUS: A SENSITIVE INDICATOR OF COPPER AND ZINC POLLUTION IN THE COASTAL ZONE,
Florida Inst. of Tech., Melbourne.
S. Barber, and J. H. Trefry.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 654-659, November, 1981. 4 Fig, 11 Ref.

Descriptors: *Bioindicators, *Barnacles, Copper, Zinc, *Pollutant identification, Fate of pollutants, Eau Gallie Harbor, Indian River Lagoon, *Florida, Bioaccumulation, Accumulation, Metals, Heavy metals, Coastal waters.

Barnacles, Balanus eburneus, were a sensitive indicator of copper and zinc pollution in the moderately polluted waters of the Eau Gallie River and Indian River Lagoon, Florida. Tissues accumulated about 36 ppm Cu for each 1 ppb increase in water Cu levels. Barnacle tissue collected at 8 sites contained 11-64 micrograms of Cu per g dry weight; dissolved Cu levels in water at these sites were 0.4 to 1.6 micrograms per liter, and total Cu, 0.8 to 2.7 micrograms per liter. Zn concentrations in barnacle tissues ranged from 360 to 12,000 micrograms per g dry weight. Possible sources of metal pollution in the system were sewage effluent, a railway trestle, and antifouling paints. (Cassar-FRC)
W82-03605

STATISTICAL MODELS FOR ESTIMATING SEAWATER METAL CONCENTRATIONS FROM METAL CONCENTRATIONS IN MUSSELS (MYTILUS EDULIS),
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Chemistry.
J. D. Popham, and J. M. D'Auria.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 660-670, November, 1981. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Mussels, *Heavy metals, *Bioindicators, Model studies, Copper, Zinc, Lead, Pollutant identification, Statistical models, Metals, Regression analysis, Water analysis, Trace metals, British Columbia, Seawater.

Field studies of copper, zinc, and lead concentrations in seawater and mussels were used to develop statistical models for estimating concentrations of trace metals in seawater, knowing the concentrations of metals in mussels. This model accounted for 50% of the variance of the soluble metal and about 20% of the metal as suspended particulate matter. Low concentrations of metals in seawater were consistently overestimated and high values, underestimated. Over 700 mussels and 25 seawater samples were collected in the southeastern coastal waters of British Columbia. These models can probably be improved by adding parameters which reflect the instantaneous effects of salinity and turbidity. (Cassar-FRC)
W82-03608

STREAM MACROINVERTEBRATE BASELINE SURVEYS: A COMPARATIVE ANALYSIS FROM THE OIL-SHALE REGIONS OF COLORADO, USA,
California Univ., Berkeley. Dept. of Forestry and Resources Management.
D. C. Erman.
Environmental Management, Vol 5, No 6, p 531-536, November, 1981. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Macroinvertebrates, *Oil shale, *Colorado, Streams, *Baseline studies, *Mining wastes, Resources development, Environmental effects, Ecosystems.

General surveys of the benthic macroinvertebrates from Piceance Creek and the White River have been conducted for nearly a decade prior to oil shale exploitation in north central Colorado. The taxa collected in four studies on Piceance Creek and in five studies on the White River showed in comparison studies that there was little similarity in results between studies, even though the studies were generally consistent in methodology, site selection, and time of year that collection of samples was made. It is suggested that this lack of agreement among the studies on what constitutes a baseline of common taxa in this area is probably a result of taxonomic difficulties and differences in technique. More emphasis should be placed on testing possible impacts than on repeated, expensive, and inconclusive baseline inventories. At present it would be impossible to identify the effects of oil-shale development, even though four or five separate studies were performed during most of a yearly cycle. (Baker-FRC)
W82-03635

MICROBIOLOGICAL QUALITY OF SELECTED RECREATIONAL WATERS,
Florida Univ., Gainesville. Dept. of Food Science and Human Nutrition.
R. J. Alvarez.
Environmental Research, Vol 26, No 2, p 372-380, December, 1981. 3 Tab, 21 Ref.

Descriptors: *Public health, *Water quality, Water use, Lakes, Streams, Rivers, Ponds, *Bacterial analysis, Pathogens, Microorganisms, Recreation, *Microbiological studies, *Florida.

The microbial quality of 18 recreational waters was evaluated in north-central Florida. These waters included lakes, streams, ponds, and creeks. Total bacterial and fungal counts, total and fecal coliforms, temperature, and pH were monitored in the summer of 1979 and winter of 1980 to observe

any seasonality associated with the quality and safety of the recreational waters. Since preliminary work had suggested the presence in various waters of lesser pathogens, five were monitored using plate count agar during the current study: Serratia marcescens, Pseudomonas aeruginosa, Yersinia enterocolitica, Edwardiella tarda, and Chromobacterium violaceum. Temperature, pH, and bacterial, fungal, total and fecal coliform counts decreased in all winter samples. However, the distribution of the selected pathogenic microorganisms seemed affected during the winter. Forty-four percent of all the recreational water sampled during the entire study contained S. marcescens, 50% contained P. aeruginosa, 56% C. violaceum, and 11% Y. enterocolitica. No E. tarda was recovered during this study. The presence of high levels of fecal coliforms and the isolation of various pathogenic microorganisms in the various waters indicates a need for closer monitoring. (Baker-FRC)
W82-03636

TRACE ANALYSES FOR WASTEWATERS,
Environmental Monitoring and Support Lab., Cincinnati, OH.
J. A. Glaser, D. L. Foerst, G. D. McKee, S. A. Quave, and W. L. Budde.
Environmental Science and Technology, Vol 15, No 12, p 1426-1435, December, 1981. 5 Tab, 31 Ref.

Descriptors: *Trace levels, *Detection limits, *Wastewater analysis, Performance evaluation, *Pollutant identification, Standard deviation, Chemical analysis, Error analysis, Detection limits, Aromatic compounds, Organic compounds, Hydrocarbons, Pesticides, Chlorinated hydrocarbons, Polychlorinated biphenyls, Insecticides, Benzidenes, Dioxin, Polynuclear aromatic hydrocarbons.

The method detection limit (MDL) is defined as the concentration of the analyte that can be detected at a given confidence level. The definition implies that, on the average, 99% of the trials measuring the analyte concentrations at the MDL must be significantly different from zero analyte concentration. MDL may be depicted as an error distribution. A procedure for determining the MDL with samples is described. The estimate may be tested by spiking the samples at the calculated MDL and repeating the procedure. Tables list MDL data on various analytical methods for organic priority pollutants in wastewater: purgeable aromatics, 0-0.4 micrograms per liter; benzidines, 0.08-0.22 micrograms per liter; organochlorine pesticides and polychlorinated biphenyls, 0.002-0.262 micrograms per liter; polycyclic aromatic hydrocarbons, 0.01-4.0 micrograms per liter; dioxin, 2 ng per liter; and miscellaneous organic compounds. The MDL varies with the analyst, method, composition of wastewater, and analyte. If the relative standard deviation of 7 replicates is 20.5-70.1%, the estimated MDL will be within the 95% confidence level of the calculated MDL. If the relative standard deviation is about 10%, the calculated MDL values can be below instrumental detection limits. (Cassar-FRC)
W82-03639

CONTIUOUS, AUTOMATED, AND LOW-COST MONITORING OF THE ORGANIC CONTENT IN WATER,
Life Systems, Inc., Cleveland, OH.
R. J. Davenport, R. A. Wynveen, and W. J. Cooper.
Journal of the American Water Works Association, Vol 73, No 10, p 555-558, October, 1981. 10 Fig, 8 Ref.

Descriptors: *Water quality, *Monitoring, *Organic compounds, Measuring instruments, Chemical analysis, Water analysis, Electrochemistry, Chemical reactions.

The electrochemical organic content (EOC) analyzer has been shown to be sensitive to individual organic compounds found in water. At present, however, the use of the EOC analyzer is in the experimental phase. The potential exists to apply the analyzer both to monitoring and to controlling operations in water treatment plants. Six organic compounds were selected for use during the feasibility demonstration of the EOC analyzer: acetic acid, methanol, urea, acetone, phenol, and a high-molecular-weight, nonionic surfactant, Triton X-100. The optimum electrode potentials and time periods for the electrode preconditioning sequence were selected on the basis that the optimum conditions would produce maximum interfacial capacitance values at the adsorption potential, without evolving excessive amounts of oxygen and hydrogen. Many organic compounds or classes of compounds exhibit a maximum adsorption at a particular potential. Therefore by lowering the adsorption potential from 0.65 to 0.25V, the methanol response is increased five times and the resultant lower limit of detection is about 2 mg/liter total organic carbon. The fact that all organic compounds do not adsorb equally can be used to advantage in detecting and monitoring certain strongly adsorbing organics when they coexist with other, less strongly adsorbing organics. Another possible use for the EOC analyzer would be monitoring water quality throughout a treatment plant. (Baker-FRC)
W82-03658

ION EXCHANGE IN FLOW INJECTION ANALYSIS DETERMINATION OF AMMONIUM IONS AT THE MICROGRAM PER LITER LEVEL IN NATURAL WATERS WITH PULSED NESSLER REAGENT,
Centro de Energia Nuclear na Agricultura, Sao Paulo (Brazil).
F. H. Bergamin, B. F. Reis, A. O. Jacintho, and E. A. G. Zagatto.
Analytica Chimica Acta, Vol 117, p 81-89, June, 1980. 7 Fig, 2 Tab, 12 Ref.

Descriptors: *Ammonium, *Water analysis, Chemical analysis, *Ion exchange, Resins, Flow system, Wastewater analysis.

Conditions for the use of ion exchangers in flow injection systems were investigated in order to develop a method for the determination of ammonium ions in natural waters at the microgram per liter level. A resin column is employed in the sample loop of an electronically operated proportional injector. Effects of sample aspiration, sampling time, eluting agent concentration, pumping rate of the sample carrier stream, resin column size, and sample acidity were studied. Consideration was also given to the possible use of sample buffering before the adsorption step. The proposed method is characterized by a precision of about two percent, a sampling rate of about 40 samples per hour, and a reagent consumption of 40 microliters per sample, and is almost free of interferences. Recoveries from 95 to 105 percent were achieved in analyzing rainwater samples with ammonium contents of less than 200 micrograms per liter. For determinations of ammonium ion in other materials such as soil extracts or wastewaters, a system with a distillation unit can be used. The system can be used for other ions in conjunction with colorimetry, potentiometry, and atomic absorption spectrometry. (Baker-FRC)
W82-03700

CADMIUM IN AN AQUATIC ECOSYSTEM,
New York Univ., NY. Dept. of Environmental Medicine.
R. E. Hazen.
PhD Thesis, February, 1981 148 p, 28 Fig, 22 Tab, 63 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-15552.

Descriptors: *Water pollution effects, *Cadmium, *Ecosystems, *Sediments, Toxicity, Heavy metals, Aquatic animals, Hazards, *Foundry Cove, Tidal effects, Hudson River, *New York.

Discharge of cadmium into Foundry Cove on the Hudson River from 1953 to 1970 accompanied the production of nickel-cadmium batteries at a nearby plant in Cold Spring, New York. The sediment surrounding the point of discharge was heavily contaminated. It was the purpose of this study to investigate the physical distribution and biological availability of the cadmium in Foundry Cove. Sediment, water and biota samples were collected and analyzed for cadmium. Laboratory exposures were conducted with fish to determine both rate of uptake and the significance of possible routes of exposure. Nine metric tons of cadmium were estimated to be in the cove sediment. Water samples typically contained from 5 to 15 micro gram Cd/liter. Animal and plant tissue samples were found to be elevated in cadmium compared to control areas. The predominant route of exposure to fish in the cove is believed to be via ingestion rather than uptake of cadmium from water through the gill. The major portion of the cadmium contamination was incorporated in the sediments with very limited availability to the water column. Nevertheless, significant elevations in cadmium concentrations were found in plants and animals in the cove. Cadmium in the blue-clay crab taken from the cove was found to be in a sufficient concentration to be a possible human health hazard. (Sinha-OEIS)
W82-03724

DEVELOPMENT OF HEALTH EFFECTS CRITERIA FOR FRESHWATER BATHING BEACHES BY USE OF MICROBIAL INDICATORS,
Oklahoma Univ., Norman.
G. L. McKee.
PhD Thesis, 1980. 219 p, 3 Fig, 18 Tab, 94 Ref, 7 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-16930.

Descriptors: *Water quality standards, *Bioindicators, *Public health, Recreation, Swimming, Pollutant identification, *Epidemiology, Escherichia coli, Microbiological studies, Oklahoma bathing beaches, Freshwater, Enterococcus, Symptomatology, *Lake Keystone.

An epidemiological-microbiological study was conducted at Lake Keystone, Oklahoma, near Tulsa, to help develop recreational water quality criteria based upon health effects. Symptomatology rates among swimmers relative to non-swimmer controls were examined at a 'barely acceptable' (BA) beach, Salt Creek Noth (I), and Keystone Ramp (II), and a 'relatively unpolluted' (RU) beach at Washington Irving South (III). This was accomplished by contacting family groups at the beaches on weekends and obtaining information on bathing activity by the use of interviewers. These beach-goers were questioned by telephone 8-10 days later concerning heath related symptoms. Measurements were made for a number of potential microbial indicators of pollution during the time the interviews were being made. When the data from the BA and RU beaches was examined, the symptom rates categorized as gastrointestinal, respiratory and 'other' were higher among swimmers than non-swimmers. Although the data were not statistically significant, definite trends could be shown in that direction. Good agreement was obtained between geometric means of Escherichia coli and enterococcus densities and the differential (swimmers minus non-swimmers) rate of gastrointestinal symptoms. The objective of relating illness as measured by symptomatology to an indicator of water quality has been addressed. (Sinha-OEIS)
W82-03730

5B. Sources Of Pollution

MINERAL ELEMENT CONTENT IN ULVA LACTUCA L. WITH REFERENCE TO EUTROPHICATION IN HONG KONG COASTAL WATERS,
Hong Kong Univ., Dept. of Botany.
Y. B. Ho.
Hydrobiologia, Vol 77, No 1, p 43-47, 1981. 1 Fig, 3 Tab.

Descriptors: *Algae, *Bioindicators, *Eutrophication, Chlorophyta, Indicators, Ulva lactuca, *Hong Kong, Nitrogen, Phosphorus, Pollutant identification, Fate of pollutants, *Coastal waters.

The green algae Ulva lactuca collected from sewage-contaminated urban sites in marine waters around Hong Kong Island were higher in tissue N

and P (44.9 and 2.7 mg per g dry weight, respectively) than algae from relatively non-polluted rural sites (27.15 and 1.45 mg per g dry weight, respectively). The mean inorganic N and soluble reactive P (in micrograms per cu dm) in seawater were as follows: urban sites, 162 and 37, respectively; rural sites, 12 and 6, respectively. There was a significant, positive correlation between the logarithmic concentration of soluble reactive P in seawater and tissue P. Levels of K and Na in the algal tissue were relatively uniform. Iron varied widely, being generally more concentrated in algae and water from urban sites. Ulva is potentially a good bioindicator for eutrophication and for heavy metal pollution. (Cassar-FRC)
W82-03417

WILL EPA'S NATIONWIDE URBAN RUNOFF STUDY ACHIEVE USEFUL RESULTS,
Colorado State Univ., Fort Collins, Dept. of Civil Engineering.
For primary bibliographic entry see Field 6E.
W82-03424

A WET-WEATHER MODEL FOR EVALUATING THE COMBINED EFFECTS OF STORM-SEWAGE OVERFLOWS AND SEWAGE-WORKS' EFFLUENTS UPON RIVER QUALITY,
Yorkshire Water Authority, Sheffields (England). Southern Div.
D. M. V. Aspinwall.
Water Pollution Control, Vol 80, No 3, p 398-410, 1981. 10 Fig, 2 Tab, 5 Ref.

Descriptors: *Combined sewer overflow, *Storm-overflow sewers, Overflow, Storm sewers, Sewers, Storm drains, Storm wastewater, *Model studies, Mathematical models, Rivers, Water quality, Water pollution sources.

A simple mathematical model is described which examines the way in which the diluting effect of rainwater upon crude sewage affects river pollution caused by storm sewage overflow discharges. The model also allows the input of sewage-treatment works final effluent and storm-sewage tank effluent so that a complete picture can be formed of the combined effects of all these discharges upon river quality. The relevance of the model output is discussed in relation to common problems such as storm-sewage overflows which discharge prematurely, rivers affording little dilution and rivers which are affected by upstream pollution. The application of the model is described for the Sheffield drainage area. In general the river dilution here is low, storm overflow settings are low, and it is to be expected that quite high levels of pollution will occur. The model is based upon steady state conditions, and a sufficient period is required to have elapsed from the start of rainfall for these conditions to be reached. The period required is a function of the time of concentration of the sewerage system together with the flow characteristics of the receiving watercourse. For small drainage areas the period will be short. For larger areas the period will be longer. Storms of short duration will produce lower levels of pollution than are predicted by the model. The situations in which it would be desirable to implement policies of separation of combined sewerage systems are those highest in storm-sewage overflows causing excessively high levels of stream pollution. If separation is unlikely, the effect of providing increased sewer capacity together with higher settings of storm sewage overflows and off line storage tanks should be investigated. Schemes for works abandonment and regionalization should be viewed cautiously, as they may lead to situations in which longer sections of the river become polluted. (Baker-FRC)
W82-03427

OUTBREAKS OF WATERBORNE DISEASE IN THE UNITED STATES: 1971-1978,
Health Effects Research Lab., Cincinnati, OH.
G. F. Craun.
Journal of the American Water Works Association, Vol 73, No 7, p 360-369, July, 1981. 10 Fig, 9 Tab, 22 Ref.

Descriptors: *Human diseases, *Drinking water, *Water distribution, Municipal water, Water quality, Contamination, Public health.

Outbreaks of waterborne disease associated with water used for drinking purposes are discussed for 1971 through 1978. Forty-three states and Puerto Rico reported 224 outbreaks which affected 48,193 individuals, two of whom died. Outbreaks in municipal and community systems naturally affected the largest number of people. These were generally caused by contamination of the distribution system, primarily through cross connections and backsiphonage. Five thousand cases of acute gastroenteritis were thought to be caused by the contamination of an uncovered storage reservoir, and 1400 cases of a similar illness were traced to sewage contamination of a water main under construction. The use of untreated, contaminated groundwater and treatment deficiencies were the primary sources of waterborne disease outbreaks in semipublic or noncommunity systems. Treatment deficiencies were responsible for 33% of all outbreaks. The number of reported outbreaks has been increasing in the United States, but this is attributed to improved surveillance. (Small-FRC)
W82-03430

INTERSTATE HIGHWAYS VERSUS WATERSHED PROTECTION IN NEW ENGLAND,
Jordan (Perkins), Inc., Reading, MA.
W. R. Adams, Jr.
Journal of the American Water Works Association, Vol 73, No 7, p 346-349, July, 1981.

Descriptors: *Watershed management, *Highway effects, *Road construction, Highways, Highway relocation, Runoff, Drinking water, Water quality, Water pollution sources, *New England.

The quality of drinking water supplies is threatened by the construction and use of interstate highways. The construction process may encourage erosion, which can add large quantities of turbid water to a reservoir. Runoff which occurs after other toxic spills that result from highway accidents are a third source of contamination. In addition, interstate highways spur further development, including shopping centers, more streets, and increases in housing construction. An example is presented of the environmental impact of a planned interstate on the Scituate Rreservoir near Providence, Rhode Island. When interstates are constructed outside of watersheds, problems associated with construction and operation are prevented and traffic is taken off the roads within the watershed. This practice is in keeping with the basic New England philosophy that every effort should be made to protect drinking water sources from further degradation. (Small-FRC)
W82-03431

A FACTOR ANALYSIS OF ELEMENTAL ASSOCIATIONS IN THE SURFACE MICROLAYER OF LAKE MICHIGAN AND ITS FLUVIAL INPUTS,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
For primary bibliographic entry see Field 2H.
W82-03442

IF YOUR CITY'S WELL WATER HAS CHEMICAL POLLUTANTS, THEN WHAT,
A. Morrison.
Civil Engineering (New York), Vol 51, No 9, p 65-67, September, 1981. 1 Fig.

Descriptors: *Groundwater pollution, *Organic solvents, Solvents, Glen Cove, *New York, Rockaway, *New Jersey, Aeration, Adsorption, Water pollution sources, Activated carbon, Potable water, Wells, Well water, Organic compounds, Trichloroethylene.

The major organic pollutants found in groundwaters are organic solvents; the most common of these are trichloroethylene and 1,1,1-trichloroethane. Recent samplings have revealed solvent contamination of groundwaters in Massachusetts, Connecticut, New Hampshire, New York, New Jersey, Delaware, Rhode Island, Pennsylvania, Florida, Michigan, and California. Other solvents that have been identified in groundwater include vinyl chloride, 1,2-dichloroethane, tetrachloroethylene, cis-1,2-dichloroethane, and carbon tetrachloride. Possible sources for these contaminants include industrial discharges, leachate from improperly managed landfills, septic tank degreasers and similar products used in individual households, sewer leaks, accidental spills, and leaks. Conventional water treatment such as coagulation, settling, precipitative softening, filtration, and perhaps disinfection are ineffective in removing most solvents. Both aeration and adsorption, however, have been found effective in decreasing concentrations of many of these contaminants. The two major adsorption methods used for this purpose are granular activated carbon and a synthetic carbon-based resin called Ambersorb XE-340. Aeration techniques found effective include packed column aeration, small cooling towers, and diffused aeration. A combination of adsorption and aeration is under study. Specific emergency situations are considered, including that in Rockaway Township, New Jersey, which is beset by pollution from two distinct sources, and Glen Cove, New York. (Baker-FRC)
W82-03451

ROCKY MOUNTAIN ARSENAL: LANDMARK CASE OF GROUNDWATER POLLUTED BY ORGANIC CHEMICALS, AND BEING CLEANED UP.
Civil Engineering (New York), Vol 51, No 9, p 68-67, September, 1981. 3 Fig, 1 Tab.

Descriptors: *Groundwater pollution, *Organic compounds, Water pollution, *Rocky Mountain Arsenal, Deep wells, Wastewater treatment, Poisons, Toxicity, Hazardous materials, *Chemical wastes.

In the 1940s chemical wastes were dumped at the Rocky Mountain Arsenal. Dumping techniques were not very sophisticated at that time, involving only placing a small dam across a low place on the Arsenal grounds, adding lime to stabilize the waste, and dumping the waste behind the dam. A problem was evident in the 1950s, when nearby crops irrigated with groundwater that had flowed under the Arsenal were damaged. Groundwater and contamination surveys were conducted, along with engineering studies, which in 1957 resulted in the construction of an asphalt-lined basin into which the above-ground liquid wastes were pumped. By the 1960s the asphalt-lined basin proved insufficient to handle all liquid wastes, so some were deep well injected into geologic strata underlying Denver. When earthquakes were detected in the Denver region, the deep well injection program was stopped. At this point the earthquakes also stopped. In 1975 the problem was taken over by the Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Maryland. Subsequently, wells have been drilled on the Arsenal grounds and used to check groundwater quality; quantity and direction of groundwater flow is being monitored; new technologies for waste treatment and control have been studied; a pilot slurry wall was constructed underground to intercept some of the groundwater flow before it leaves the Arsenal; and the intercepted flow is pumped out, run through granular activated carbon beds, and the cleansed water returned to the ground via other wells downflow of the wall. A team of specialists is now being assembled to help determine the most cost-effective alternatives for addressing the total contaminant problem. (Baker-FRC)
W82-03458

PALAEOECOLOGICAL STUDIES OF THE RECENT DEVELOPMENT OF LAKE VAXJOSJON. III. REASSESSMENT OF RECENT CHRONOLOGY ON THE BASIS OF MODIFIED PB210 DATES,
University Coll., London (England).
R. W. Battarbee, G. Digerfeldt, P. Appleby, and F. Oldfield.
Archiv fur Hydrobiologie, Vol 89, No 4, p 440-446, August, 1980. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Sedimentation, *Lead, *Dating, *Lake sediments, Paleolimnology, Deposition, *Fate of pollutants, Lake Vaxjosjon.

Dates of lead pollution in sediments in Lake Vaxjosjon were recalculated using the assumption of a constant net rate of supply (c.r.s.) of unsupported Pb210 to the sediment. Dates had previously been determined on the assumption that there was a constant initial concentration (c.i.c.) of unsupported Pb210 per unit dry weight of sediment at each sampled depth. For the eight samples down to the 140 cm depth (1880) there was reasonably good agreement between the two calculation methods, suggesting a rather uniform dry mass accumulation rate during this period. The last two samples, 155-160 cm and 175-180 cm, were dated 1898 and 1875, respectively, by the c.i.c. method and 1868 and 1786, respectively, by the c.r.s. method. Sediment accumulation rates determined by the c.r.s. method (0.148 g per sq cm per a) correlated better with historical evidence such as dredging, lake lowering, and pollution inputs than rates determined by c.i.c. (0.135 g per sq cm per a). (Cassar-FRC)
W82-03480

DEGRADATION OF PENTACHLOROPHENOL IN SIMULATED LENTIC ENVIRONMENT,
Fish and Wildlife Service, Columbia, MO.
T. P. Boyle, E. F. Robinson-Wilson, J. D. Petty, and W. Weber.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 2, p 177-184, 1980. 1 Fig, 3 Tab, 23 Ref.

Descriptors: *Biodegradation, *Aquatic environment, *Ecosystems, *Aerobic bacteria, *Phenols, Organic compounds, Euphotic zone, Zones, Water pollution, Benthic environment, Benthos, Experimental design, Gas chromatography, Lentic environment, Standing waters.

The persistence of pentachlorophenol (PCP) in various aquatic environments was investigated. Four aquaria were established, simulating four lentic environments: the oxygen rich epilimnion, the oxygen rich euphotic littoral zone, and low oxygen, dark hypolimnion, and a benthic hydrosoil-hypolimnion. The degradation of PCP, formation of TCP and PCA, and the distribution of metabolites were observed over a 131 day period. Results suggest that the persistence of PCP was associated with three variables: (1) the absence of light and hydrosoil, (2) a pH near or below the pka of 4.8, and (3) low oxygen concentration. The conversion of PCP to TCP does not appear to be the major pathway in water, but may be more important in hydrosoil. (Titus-FRC)
W82-03489

STUDY OF THE TRANSFER OF CD, PB, CU, AND ZN IN NERITIC AND ESTUARINE TROPHIC CHAINS - I. STATE IN THE INTERNAL ESTUARY OF THE LOIRE (FRANCE) DURING THE SUMMER OF 1978. (ETUDE DU TRANSFERT DE CD, PB, CU ET ZN DANS LES CHAINES TROPHIQUES NERITIQUES ET ESTUARIENNES - I. ETAT DANS L'ESTUAIRE INTERNE DE LA LOIRE (FRANCE) AU COURS DE L'ETE 1978),
Nancy-1 Univ. (France). Lab de Chimie et d'Electrochimie Analytique et d'Hydrologie.
J-C. Amiard, C. Amiard-Triquet, C. Metayer, J. Marchand, and R. Ferre.
Water Research, Vol 14, No 6, p 665-673, June, 1980. 5 Fig, 5 Tab, 20 Ref.

Descriptors: *Trace metals, *Food chains, *Estuaries, Bioaccumulation, Heavy metals, Metals, Crustaceans, Fish, Loire, *France, Path of pollutants.

Different species of crustaceans and fish were taken from the Loire estuary on the banks of Bilho and Pipy to determine the behavior of some trace elements (Cd, Pb, Cu, Zn) in estuarine biota. Except for Zn, the accumulation of metals was higher in crustaceans than in fishes, which was particularly pronounced for Cu, a constituent of the crustacean respiratory pigment hemocyanine. The metal concentrations, determined by atomic absorption, were no greater in bottom-feeders than for other fish, indicating that metal transfer from sediments was unimportant. Biological accumulation decreased in the order Zn > Cu > Pb > Cd. The Loire organisms were generally less contaminated than those of the same species taken from heavily polluted estuaries (Severn and Medway, England). Transfers in food chains were determined with the transfer factor, equal to the ratio of the predator concentration to the prey concentration. There was no indication of any biomagnification in food chains for Cd, Pb and Cu, since the amounts observed in the predators were generally less than those of prey or in the digestive content. For Zn the transfer factor was > 1 with one exception (Neyomysis integer - Crangon crangon). The higher concentrations in the intestines than in the stomach were probably due to feces enrichment by unassimilated metals. (Hertzoff-FRC)
W82-03492

IRRIGATED AGRICULTURE AND NITRATE POLLUTION OF RURAL WATER SUPPLIES: ECONOMICS FOR POLICY IN CENTRAL WISCONSIN,
Wisconsin Univ.-Madison. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 5G.
W82-03512

ARSENIC IN LAKE LANSING, MICHIGAN,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
T. R. Batterson.
PhD Thesis, 1980. 94 p, 12 Fig, 4 Tab, 55 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-06466.

Descriptors: *Lakes, *Arsenic, *Water pollution, Pollutant identification, Water pollution sources, Aquatic weed control, Sediments, *Lake Lansing, *Michigan.

Lake Lansing, Michigan was treated with sodium arsenite for control of aquatic macrophytes in 1957. The rate of decrease in recently deposited sediments predicted that concentrations near background would exist in surficial sediments in the deep portions of the basin by 1989. One hundred ten samples of the upper 7 cm of littoral sediments were taken along transects. Concentrations two to six times background occurred over 85-90% of the sediment surface. An arsenic mass balance budget was constructed for the lake for the interval June 1978 to June 1979. This showed that the lake lost more arsenic than it received annually. A laboratory experiment was conducted to obtain predictions of arsenic expected in the lake as a result of interactions between contaminated sediments and the water column. Since sediments in the well aerated littoral, as well as those from the periodically anaerobic hypolimnion were contaminated, aerobic and anoxic treatments were compared. It appears that As(V) and phosphate compete for iron as anoxic systems are aerated. Concentrations of arsenic observed in the lake fit expectations from the experimental work. Currents associated with summer storms periodically erode the metalimnion of this shallow lake. Except for infrequent summer periods, sulfide or ferric iron tend to limit total arsenic in the hypolimnion. (Sinha-OEIS)
W82-03522

MOVEMENT OF COBALT IN FRESHWATER MICRO-ECOSYSTEMS,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 2H.
W82-03524

METHANOGENESIS IN MARINE SEDIMENTS OF THE MISSISSIPPI RIVER DELTA,
Louisiana State Univ., Baton Rouge. Dept. of Microbiology.
L. A. Hook.
PhD Thesis, May, 1981. 167 p, 30 Fig, 9 Tab, 83 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-17631.

Descriptors: *Methane, *Sediments, *Bacteria, *Deltas, Anaerobic conditions, Sulfur bacteria, Environmental effects, Microbiological studies, *Mississippi River, *Methanogenesis, Marine sediments, Sulfate-reducing bacteria.

The final processes of carbon mineralization in anaerobic sediments are chiefly governed by two groups of strictly anaerobid microorganisms: sulfate-reducers and methanogens. The highest most probable numbers (MPNs) of methanogens and sulfate-reducers in unstable, gas-rich, Mississippi River delta sediments occurred together in samples taken 0.2 m below the sediment-water interface. The presence of sulfate-reducers was directly related to dissolved sulfate in the interstitial water. Dissolved methane in the sediments was inversely related to the presence of sulfate-reducing bacteria. The extensive depth distributions of methanogens and sulfate-reducers, plus the occurrence of two sulfate-reducing zones, were the result of sediment mixing during undersea landslides that frequently occurred in the delta. Methanogenesis was sensitive to 2-bromoethanesulfonate, chloroform, nitrate, air, and formaldehyde, but not to added Beta-fluoroacetate, sulfide, or sulfate. The optimum temperature for methanogensis in enrichments and in unadulterated sediments was 35-40 C and 45 C, respectively. The production of methane from choline, in addition to the isolation of desulfovibrios capable of producing trimethylamine from choline, implicated trimethylamine as a possible methane precursor in the delta sediments. (Sinha-OEIS)
W82-03533

DEGRADATION OF POLYCHLORINATED BIPHENYLS IN SEDIMENTS OF THE GREAT LAKES,
Michigan Univ., Ann Arbor. Dept. of Environmental and Water Resources Engineering.
M. L. Anderson.
PhD Thesis, 1980. 275 p, 59 Fig, 24 Tab, 162 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-25646.

Descriptors: *Polychlorinated biphenyls, *Sediments, *Degradation, *Microbial degradation, Experimental data, Aeration, Bacteria, Chemical properties, Water quality, Fate of pollutants, *Great Lakes, Saginaw Bay.

The central hypothesis of this research is that microbial degradation of PCBs in the Great Lakes might be significant. Because of the long residence time of PCBs in the Great Lakes, this removal mechanism could be significant even if the rate of degradation is slow. Some conclusions reached are: Bacteria exist in sediments of Saginaw Bay and River which are capable of degrading chlorobiphenyls at rates which are significant. The degradation of chlorobiphenyls in incubated sediments is enhanced by aeration and mixing of the system. The degradation of di- and trichlorobiphenyis is extremely rapid in incubated sediments. Tetra and pentachlorobiphenyls are also degraded but at slower rates. The rate of degradation of 2, 4, 5, 2', 5'-pentachlorobiphenyls has a significant impact upon simulated Aroclor 1254 concentrations in Saginaw Bay. None of the chlorobiphenyls employed were degraded in sediments incubated under anaerobic conditions. And finally, degradation of chlorobiphenyls in the Great Lakes appears to take place predominantly in the aerobic surface layer of sediments. (Sinha-OEIS)
W82-03536

GROUND WATER SEEPAGE IN LAKE WASHINGTON AND THE UPPER ST. JOHNS RIVER BASIN, FLORIDA,
New Hampshire Water Supply and Pollution Control Commission, Concord.
For primary bibliographic entry see Field 2H.
W82-03546

THE ADSORPTION CHARACTERISTICS OF SOILS AND REMOVAL OF CADMIUM AND NICKEL FROM WASTEWATERS,
College of Petroleum and Minerals, Dhahran (Saudi Arabia).

For primary bibliographic entry see Field 5E.
W82-03553

ACIDIFICATION OF SURFACE WATERS IN TWO AREAS OF THE EASTERN UNITED STATES,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
D. A. Burns, J. N. Galloway, and G. R. Hendrey.
Water, Air, and Soil Pollution, Vol 16, No 3, p 277-285, October, 1981. 2 Tab, 32 Ref.

Descriptors: *Acidic water, *Streams, *Acid rain, *New Hampshire, *North Carolina, Blue Ridge Mountains, White Mountains, Hydrogen ion concentration, Alkalinity, Surface waters, Lakes, Air pollution, Water pollution sources.

Some acidification of surface waters has occurred in 2 undisturbed, upland watersheds in New Hampshire's White Mountains and North Carolina's Blue Ridge Mountains. The New Hampshire waters had a pH of 6.06 in 1979 vs. 6.66 in 1936-39. The North Carolina waters declined in pH from 6.77 in 1961-64 to 6.51 in 1979. Recent determinations of Ca, Mg, Na, and K were compared with bicarbonate alkalinity. The current ratios of bicarbonate alkalinity to the sum of the base cations were 0.312 for New Hampshire and 0.562 for North Carolina. These may be compared with ratios from western lakes receiving no acid precipitation (0.776-0.942) and some acid lakes in Connecticut (0.333), Maine (0.427), and Scandinavia (0.064). Acidification was more pronounced in New Hampshire waters, corresponding with historical data that New Hampshire has been receiving precipitation of average annual pH below 4.5 since at least 1955, whereas North Carolina precipitation in 1955 had a pH of 4.7-5.2, and in 1963, 5.0. (Cassar-FRC)
W82-03554

ANALYTICAL SOLUTIONS FOR TRANSPOT OF CONSERVATIVE AND NONCONSERVATIVE CONTAMINANTS IN GROUNDWATER SYSTEMS,
Instituut voor Culturrtechniek en Waterhuishouding, Wageningen (Netherlands).
J. Hoeks.
Water, Air, and Soil Pollution, Vol 16, No 3, p 339-350, October, 1981. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Solute transport, *Waste disposal, Model studies, *Path of pollutants, *Groundwater pollution, Leachates, Landfills, Groundwater movement, Adsorption, Degradation, Water quality, Zinc, Ammonium, Chlorides, Organic compounds.

A simple model for contaminant transport in groundwater is developed to help select sites for waste disposal. Data needed are soil profile, hydrologic parameters, and soil interaction processes (adsorption, decomposition). Equations describing the flow of groundwater along streamlines are combined with equations for interaction processes. Dispersion is neglected. An example is given where a waste tip (200 m in diameter) is in an area of divergent radial groundwater flow with concentric equipotential lines. Infiltration into upper soil and aquifer is 200 mm per year. After 50 years ammonium and Zn have been retarded; organic compounds have been degraded within 100 m. Vertical penetrations are 21 m for Cl, 17 m for ammonium, 2.6 m for Zn, and 10 m for organic compounds. (Cassar-FRC)
W82-03555

LOSSES OF NITROGEN, PHOSPHORUS AND POTASSIUM FROM AGRICULTURAL WATERSHEDS OF MINOR RIVERS IN THE OKA VALLEY,
Akademiya Nauk SSSR, Moscow. Inst. Agrokhimii i Pochvovedeniya.
V. N. Kudeyarov, V. N. Bashkin, and A. Y. Kudeyarova.
Water, Air, and Soil Pollution, Vol 16, No 3, p 267-276, October, 1981. 2 Fig, 4 Tab, 24 Ref.

Descriptors: *Nutrients, *Fertilizers, *Agricultural runoff, Fate of pollutants, Agricultural watersheds, Nitrogen, Phosphorus, Potassium, *Oka Valley, *USSR, Rivers.

Concentrations of nitrogen, phosphorus, and potassium were measured in the rivers and principal tributaries of the Oka Valley, near Moscow, from July 1977 to March 1980, with simultaneous estimation of the water discharge. Nutrient losses in the four tributary valleys of the Oka Valley were highly correlated with the amounts of mineral and organic fertilizers applied to the soil. The four valleys differed in rate and timing of fertilizer application, soil type, crops, and erosion characteristics. Nutrient losses were also higher in regions with greater natural soil fertility, greater erosion, and light-textured soils, and in the flood season. (Cassar-FRC)
W82-03556

COMPARISON OF FIVE DIFFERENT METHODS FOR MEASURING BIODEGRADABILITY IN AQUEOUS ENVIRONMENTS,
Battelle Columbus Div., OH.
For primary bibliographic entry see Field 1B.
W82-03557

SULFUR CONTITUENTS OF SEDIMENTS AND THEIR RELATIONSHIP TO LAKE ACIDIFICATION,
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse. Dept. of Environmental and Forestry Biology.
M. J. Mitchell, D. H. Landers, and D. F. Brodowski.
Water, Air, and Soil Pollution, Vol 16, No 3, p 351-359, October, 1981. 3 Fig, 3 Tab, 35 Ref.

Descriptors: *Lake sediments, *Sulfur compounds, *Acid rain, Fate of pollutants, Sediments, Acidic water, Sulfates, Decomposition, Lakes, Oneida Lake, Deer Lake, South Lake, *New York, Water pollution effects.

The organic and inorganic sulfur fraction in 3 New York lake sediments were determined. These lakes, subjected to acid precipitation, differed in buffering capacity and pH. pH and acid neutralizing capacity (in meq per liter) respectively were: Oneida, 7.2-9.4 and 1700; South, 4.9-6.5 and 2-10; and Deer, 5.9-6.8 and 90-124. Total sulfur in sediments was lowest in Oneida (0.1-0.3% dry mass). South (0.25-0.65%) and Deer (0.3-0.5%) sediments had higher S levels near the outlets. Sulfides were highest in Oneida (1% of total S) which had the lowest redox potential (-80 to -110 mV). South and Deer contained about 0.2% sulfides. Inorganic S varied from 8% of total S in Deer to 22% in Oneida. Ester sulfates were 80% of total S in Oneida and Deer, and 45% in South. Oxygen consumption was highest in Oneida and lowest in South sediments. The low ester sulfate and higher carbon/nitrogen ratio in South sediments suggest that lake acidification may inhibit decomposition. (Cassar-FRC)
W82-03558

BOTTOM SEDIMENTS AS A SOURCE OF NITROGEN AND PHOSPHORUS IN WATER,
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
M. V. Martynova.
Water Resources, Vol 8, No 1, p 91-106, January/February, 1981. 2 Fig, 8 Tab, 58 Ref. Translated from Vodnye Resursy, No 1, p 164-182, January/February, 1981.

Descriptors: *Nitrogen removal, *Phosphorus removal, *Sediments, Fate of pollutants, Bottom sediments, *Lake sediments, Nutrients, Eutrophication, Reviews, Adsorption, Phosphates, Ammonium compounds, Model studies, Clays, Chemical reactions.

Literature on bottom sediments and their release of nutrients into the water is reviewed with emphasis on publications of the 1970's. This stage of the investigations is concerned with the role of sediments in the prediction and regulation of water quality, mainly phosphorus levels. Two methods of investigation are common: aquarium experiments and on-site observations. Several factors influence the exchange of N and P between sediments and water. Anaerobic conditions promote P mobilization. Phosphate concentrations greater than 1-2 mg per liter are readily adsorbed into sediments under both aerobic and anaerobic conditions. Oxygen levels do not affect the rate of removal of ammonium N from sediments. Maximum phosphate adsorption takes place at lower pH (4-5) on kaolinite and illite, at higher pH (10+) on montmorillonite, and in clays with higher Fe content. Both P and N removal are greater at higher water temperatures and at higher microbial activity levels. Models describing P and N exchange in sediments are based on mechanisms or on experimentally determined relationships between the release rates of N and P-containing compounds and their content in the sediment. Concentration diffusion is the main method of passage of N from sediments into water. The P removal mechanism is more complex, and not all the processes are completely understood. (Cassar-FRC)
W82-03571

BOUNDARY INTEGRAL EQUATION SOLUTIONS TO MOVING INTERFACE BETWEEN TWO FLUIDS IN POROUS MEDIA,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2F.
W82-03577

MASS TRANSPORT. 3. ROLE OF HYDRAULIC CONDUCTIVITY DATA IN PREDICTION,
British Columbia Univ., Vancouver. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2G.
W82-03578

PATTERNS OF GROUNDWATER SALINITY CHANGES IN A DEEP CONTINENTAL-OCEANIC TRANSECT OFF THE SOUTHEASTERN ATLANTIC COAST OF THE U.S.A.,
Scripps Institution of Oceanography, La Jolla, CA.
For primary bibliographic entry see Field 2F.
W82-03582

SULFUR AND OXYGEN ISOTOPES AS TRACERS OF THE ORIGIN OF SULFATE IN LAKE CRETEIL (SOUTHEAST OF PARIS, FRANCE),
Paris-6 Univ. (France). Lab. de Geologie Dynamique.
For primary bibliographic entry see Field 2H.
W82-03583

CHARACTER OF BRINES FROM THE BELLE ISLE AND WEEKS ISLAND SALT MINES, LOUISIANA, U.S.A.,
Louisiana State Univ., Baton Rouge. Inst. of Environmental Studies.
For primary bibliographic entry see Field 2F.
W82-03584

PERSISTENCE OF DIELDRIN IN WATER AND CHANNEL CATFISH FROM THE DES MOINES RIVER, IOWA, 1971-73 AND 1978,
Minnesota Pollution Control Agency, Roseville.
S.-Y. T. Leung, R. V. Bulkley, and J. J. Richard.
Pesticides Monitoring Journal, Vol 15, No 2, p 98-102, September, 1981. 2 Fig, 5 Tab, 15 Ref.

Descriptors: *Fate of pollutants, *Dieldrin, *Catfish, *Water pollution effects, Bioaccumulation, Pesticides, *Insecticides, Water pollution, Rivers, Aldrin, Environmental effects, Ecological effects, Runoff.

The levels of the organochlorine insecticide, dieldrin, in the Des Moines River, Iowa and in channel catfish (Ictalurus punctatus) from the river were compared based on studies done before and after the banning of the parent pesticide aldrin by the Environmental Protection Agency in 1975. In river water, the mean June levels of dieldrin decreased from 50 parts per trillion (ppt) in 1971 to 11 ppt in 1978. In 1971 the average daily transport of dieldrin was 156 g, as compared to a value of 70

g in 1978. Average levels of dieldrin in catfish muscle recorded in July were 75 parts per billion (ppb) in 1973 and 46 ppb in 1978. Three years after the registration of the parent compound aldrin was withdrawn, dieldrin was still found at significant levels in the Des Moines River. The long half-life of this chemical under certain environmental conditions indicates that dieldrin will be present in the river for some years. (Geiger-FRC)
W82-03590

SEEPAGE FLOW IN EXTREMELY THIN AQUIFERS,
Bochum Univ. (Germany, F.R.). Inst. fuer Konstruktiven Ingenierbau.
For primary bibliographic entry see Field 2F.
W82-03594

FIELD OBSERVATIONS OF FRONTS AND HIGH-FREQUENCY TEMPERATURE FLUCTUATIONS IN A THERMAL PLUME,
Wisconsin Univ.-Madison. Marine Studies Center.
T. Green, and S. Roffler.
Advances in Water Resources, Vol 4, No 3, p 137-145, September, 1981. 16 Fig, 1 Tab, 18 Ref.

Descriptors: *Plumes, *Thermal water, *Nuclear powerplants, Thermal pollution, Temperature gradient, Powerplants, Outfall, Turbulent flow, Cooling water, *Lake Michigan, Mixing, Flow pattern, Fate of pollutants.

High frequency temperature variations were measured at seven depths 130 meters from the cooling water outfall of the Point Beach Nuclear Plant on Lake Michigan. Techniques used to analyze the data included temperature spectra, correlation functions, and probability distributions. Sharp, concentric thermal fronts observed in the data compare with those obtained from aircraft infrared imagery and to laboratory studies of instabilities in maxing layers between uniformly flowing and quiescent liquids. This work gives firm evidence of the existence of mature, two-dimensional vortical structures in a high Reynolds number flow in the natural environment. It is believed that the lake bottom is not directly responsible for the observed structures. The mean temperatures at various depths were as follows: 20.7C at the surface, 19.2C at 1 m, 17.4C at 2 m, and 14.3C at 3 m. (Cassar-FRC)
W82-03595

KINETICS OF TRIHALOMETHANE FORMATION IN LYOPHILIZED POTOMAC WATER,
Howard Univ., Washington, DC. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5F.
W82-03596

TREATABILITY AND PATHWAYS OF PRIORITY POLLUTANTS IN THE BIOLOGICAL WASTEWATER TREATMENT,
Environmental Protection Agency, Washington, DC.
S. T. Hwang.
AIChE Symposium Series, Vol 77, No 209, p 316-326, 1981. 5 Fig, 26 Ref.

Descriptors: *Kinetics, *Biodegradation, *Air stripping, *Adsorption, *Wastewater treatment, Biological treatment, Sludge, *Fate of pollutants, Mass transfer, Diffusion coefficient, Priority pollutants, Organic compounds, Metals, Activated sludge process.

A review of state-of-the-art literature on biodegradation kinetics, air stripping, and adsorption on sludge of priority pollutants resulted in a unified framework by which to quantify removal of toxic chemicals by multimedia pathways in biological wastewater treatment systems. Biodegradation of toxic chemical substances is best described by Grau kinetics. An estimate of mass transfer coefficients in air stripping can be obtained from the ratio of the diffusion coefficient, molecular weights, or critical volumes in conjunction with a known value of the mass transfer coefficient. Sludge adsorbs some priority pollutants, primarily polynuclear aromatic compounds, metals, and cyanides. The disappearance of a specific toxic pollutant in sludge in nonbiodegradable form can be represented by the multicomponent adsorption equation of Langmuir type based on the binary characterization of wastewater adsorption. (Cassar-FRC)
W82-03599

COMPARATIVE STUDY OF THE TROPHIC TRANSFER OF TWO MERCURY COMPOUNDS--HGCL2 AND CH3HGCL--BETWEEN CHLORELLA VULGARIS AND DAPHNIA MAGNA. INFLUENCE OF TEMPERATURE,
Bordeaux-1 Univ., Talence (France). Lab. d'Ecologie Animale.
A. Boudou, and F. Ribeyre.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 624-629, November, 1981. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Bioaccumulation, *Aquatic life, *Mercury, Algae, Daphnia, Chlorella, Invertebrates, Temperature effects, Water pollution effects, Methylmercury, *Fate of pollutants, Organomercury compounds.

The transfer of two mercury compounds, mercuric chloride and methyl mercury chloride, between a producer level species (Chlorella vulgaris) and a primary consumer (Daphnia magna) was compared at 10 and 18C. Metal concentrations were 1 ppb. Chlorella took up 86% and 96% of initial Hg from mercuric chloride at 10 and 18C, respectively, and 100% and 98% of initial Hg from methyl mercury at 10 and 18C, respectively. Daphnia exposed to the contaminated chlorella for 4 days accumulated 6% Hg at both 10 and 18C in the mercuric chloride flasks and 21% and 58% Hg at 10C and 18C, respectively, in the methyl mercury flasks. At the higher temperature Daphnia ingest more food. The identical Hg accumulation rates of Daphnia in mercuric chloride at both temperatures are explained by some direct contamination at 10C. (Cassar-FRC)
W82-03602

BALANUS EBURNEUS: A SENSITIVE INDICATOR OF COPPER AND ZINC POLLUTION IN THE COASTAL ZONE,
Florida Inst. of Tech., Melbourne.
For primary bibliographic entry see Field 5A.
W82-03605

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY, VOLUME I; GENERAL.
Environmental Protection Agency, DC. Effluent Guidelines Div.
Report EPA-400/1-80/024-b, December, 1980. 463 p, 8 Fig, 65 tab, 153 Ref, 3 Append.

Descriptors: *Steel industry, *Industrial wastes, *Water pollution sources, *Water pollution control, *Wastewater treatment, Effluents, Pollutants, Flow control, Toxicity, Organic compounds, Inorganic compounds, Water quality standards, Costs.

This volume discusses the general issues pertaining to development of BPT, BCT, and BAT effluent limitations, pretreatment standards for new and existing sources (PSNS and PSES) and new source performance standards (NSPS) for the steel industry. Regulations and proposed for twelve recognized subcategories of the industry. For the most part, the BPT effluent limitations promulgated in 1974 and 1976 are practicable and achievable by all steel facilities. The BAT limitations are more stringent, and are expected to reduce process flow by 90%, toxic organics by 92%, and other pollutants by 93% compared with the BPT limitations. In most cases the NSPS are equal to the proposed BAT effluent limitations. In most cases the proposed standards for toxic pollutants for PSES abd PSNS are the same as the limitations proposed for BAT. The costs for implementing the BPT and BAT limitations are estimated. (Brambley-FRC)
W82-03624

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY, VOL II: COKE MAKING SUBCATEGORY, SINTERING SUBCATEGORY, IRON MAKING SUBCATEGORY,
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
Report EPA-440/1-80/024b, December, 1980. 457 p, 66 Fig, 122 Tab.

Descriptors: *Steel industry, *Industrial wastes, *Water pollution sources, *Wastewater treatment, Effluents, Pollutants, Suspended solids, Flow control, Oil, Grease, Ammonia, Cyanides, Phenols, Organic compounds, Benzenes, Residual chlorine, Heavy metals, Costs, Water pollution control.

This volume contains the effluent limitations for BPT, BCT and BAT, as well as pretreatment standards for existing and new sources (PSES and PSNS) and new source performance standards (NSPS) for the cokemaking, sintering, and ironmaking subcategories of the steel industry. The cokemaking subcategory has proposed limitations and standards for flow, total suspended solids, oil and grease, ammonia-nitrogen, total cyanide, phenols, benzene, naphthalene, benzo(a)pyrne, and pH. Separate BAT limitations will be proposed for those existing sources which have full scale physical/chemical BAT treatment systems. For the sintering subcategory, limitations are proposed for flow, total suspended solids, oil and grease, ammonia-nitrogen, total cyanide, phenols, total residual chlorine, lead, zinc, and pH. By controlling cyanide and phenols control of other organics is expected, and by controlling lead and zinc control of toxic metals is expected. Similar control is expected by the limitations proposed for the ironmaking category for these pollutants. Limitations for the ironmaking category are proposed for flow, total suspended solids, total cyanide, ammonia-nitrogen, phenols, total residual chlorine, lead, zinc, and pH. Cost estimates for implementing each control strategy for each subcategory are presented. (Brambley-SRC)
W82-03625

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY, VOL IV: HOT FORMING SUBCATEGORY.
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
Report EPA-440/1-80/024-b, December, 1980. 383 p, 77 Fig, 137 Tab.

Descriptors: *Steel industry, *Industrial waste, *Wastewater treatment, *Water pollution sources, *Water pollution control, Zero discharge, Flow control, Metals, Toxicity, Water reuse, Oil, Grease, Pollutants, Effluents, Suspended solids.

This volume contains the proposed effluent limitations for BPT, BCT, and BAT, pretreatment standards, for new and existing sources (PSNS and PSES) and new source performance standards (NSPS) for the hot forming subcategory of the steel industry. The subcategory has four subdivisions - primary, section, flat, and pipe and tube. Limits are proposed for flow, totals suspended solids, oil and grease, and toxic metals, and cost estimates are given. Extensive recycle of hot forming wastewaters considered as components of the BAT, NSPS and pretreatment alternative treatment system is considered appropriate to minimize toxic pollutant discharge from hot forming operations. The proposed BCT limitations are based on recycle and filtration, which are fully compatible with the technology used to develop the proposed BAT limitations. Some hot forming operations are

achieving zero discharge, using BPT, BAT, and BCT treatment model components. The EPA is soliciting comments on whether zero discharge limitations and standards should be proposed at the BAT, BCT, and NSPS levels. (Brambley-SRC)
W82-03627

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENTS LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY, VOL V: SCALE REMOVAL SUBCATEGORY, ACID PICKLING SUBCATEGORY.
Environmental Protection Agency, Washinton, DC. Effluent Guidelines Div.
Report EPA-440/1-80/024-b, December, 1980. 529 p, 121 Fig, 183 Tab.

Descriptors: *Steel industry, *Iron industry, *Industrial wastes, *Wastewater treatment, *Water pollution sources, *Water pollution control, Pollutants, Effluents, Toxicity, Metals, Organic compounds, Flow control, Inorganic acids, Costs, Iron, Fluorides, Suspended solids.

This volume contains the proposed effluent limitations guidelines and standards for the scale removal and acid pickling subcategories of the iron and steel industry. In the scale removalsubcategory the kolene and hydride scale removal subdivisions are retained. Proposed BTP and BAT limitations are given for flow, total suspended solids, toxic metals, toxic organics, and other pollutants for both subdivisions with estimates of their costs. The proposed new source performance standards (NSPS) and the NSPS model treatment system are similar to the proposed BAT limitations and the BAT model tretment system, respectively. Standards intended to minimize the impact of pollutants on publicly owned treatment works (POTW) are proposed for new and existing sources discharging wastewaters to such works. Adequate control of those toxic pollutants not specifically limited is to be attained by controlling the pollutants for which limitations are proposed. The acid pickling subcategory contains three subdivisions - sulfuric, hydrochloric, and combination. BPT and BAT limitations are proposed for flow, total suspended solids, oil and grease, toxic metals, toxic organics, dissolved iron, and fluoride, and the costs are estimated. These standards will also apply to NSPS operations, except sulfuric acid pickling which will have zero discharge. Pretreatment standards are proposed for new and existing sources to limit the amount of toxic and other pollutants dishcarge to POTW's. (Brambley-SRC)
W82-03628

BIODEGRADATION OF LINEAR ALCOHOL ETHOXYLATES IN NATURAL WATERS,
Procter and Gamble Co., Cincinnati, OH.
R. J. Larson, and L. M. Games.
Environmental Science and Technology, Vol 15, No 12, p 1488-1493, December, 1981. 5 Fig, 2 Tab, 21 Ref.

Descriptors: *Surfactants, *Biodegradation, *Kinetics, Fate of pollutants, Detergents, Organic compounds, Linear alcohol ethoxylates, Degradation, Mineralization, Temperature effects, Thermodynamics, Water pollution control.

Linear alcohol ethoxylates (LAE's), a class of nonionic surfactants, biodegraded rapidly in Ohio River water at concentrations of environmental concern, 1 to 100 micrograms per liter. Degradation was first order with respect to concentration. Two pure-chain-length materials (C12E9 and C16E3) were used in the study. They were uniformly labeled with C14 in the ethoxylate chain or at the alpha carbon in the alkyl chain. Neither the alkyl nor ethoxylate chain length significantly affected the rate or degree of degradation. A C17E22 material showed degradation kinetics similar to these of the shorter-chain-length LAE's. The Arrhenius equation described the temperature effects on the rate of ethoxylate degradation from 3 to 34 C. Calculated activation energy was 9.5 kcal per mol for the C16E3 material. The C12E9 ethoxylate chain showed a somewhat similar pattern with deviations at the high and low temperature extremes. (Cassar-FRC)
W82-03638

MIGRATION THROUGH SOIL OF ORGANIC SOLUTES IN ALJ OIL-SEALE PROCESS WATER,
Geological Survey, Denver, CO.
J. A. Leenheer, and H. A. Stuber.
Environmental Science and Technology, Vol 15, No 12, p 1467-1475, December, 1981. 12 Fig, 3 Tab, 8 Ref.

Descriptors: *Soil adsorption capacity, *Oil shale, *Solute transport, Fate of pollutants, Adsorption, Soil columns, Organic carbon, *Leachates, Organic matter, Ammonium salts, Amines.

Migration of organic solutes in an oil shale retort water was studied in fine loamy soil columns. Dissolved organic carbon fractionation and high performance liquid chromatography were used to analyze leachates. The order of affinity of the fractions in retort water for soil was as follows: hydrophilic neutrals = hydrophilic acids < hydrophobic acids < hydrophilic bases < hydrophobic bases < hydrophobic neutrals. Retort water leached significant amounts of organic acids from the soil columns, and the soil selectively adsorbed some types of organic solutes from the water. Ammonium ions in the retort water extracted organic acids from the soil. A distilled water rinse after retort water leaching produced flush peaks of organic solutes. This was a result of the relaxation of the common ion effect as ammonium concentration decreased during the rinse. Aromatic amines in the hydrophobic and hydrophilic base fractions had the same relative order of rates of migration through the soil column as on a reversed-phase octadecylsilica liquid chromatographic column. Soil is an effective adsorbent for spills of no greater than one void volume. Application of more than one pore volume would produce migration of organic solutes and extraction of soil organic matter. Rain falling on the site of a retort water spill would also enhance migration and extraction of dissolved organics. (Cassar-FRC)
W82-03640

'ACID RAIN', DISSOLVED ALUMINUM AND CHEMICAL WEATHERING AT THE HUBBARD BROOK EXPERIMENTAL FOREST, NEW HAMPSHIRE,
Dartmouth Coll., Hanover, NH. Dept. of Earth Sciences.
N. M. Johnson, C. T. Driscoll, J. S. Eaton, G. E. Likens, and W. H. McDowell.
Geochimica et Cosmochmica Acta, Vol 45, No 9, p 1421-1437, September, 1981. 10 Fig, 7 Tab, 43 Ref.

Descriptors: *Acid rain, *Weathering, *Soil chemistry, Fate of pollutants, *Aluminum, Forests, Stream order, Acid streams, Streams, Chemical reactions, Silicates, Neutralization, Water quality, Hubbard Brook, Falls Brook, *New Hampshire, Fluorides.

The effects of acid rain were studied in Hubbard Brook Experimental Forest, where water quality and hydrologic data has been regularly sampled since 1963. Water samples were also collected at 9 sites along Falls Brook (first through fifth order stream) from February 1975 to February 1978. The watershed contains bedrock of high grade metamorphic rocks and granites overlain with glacial till composed of granites and schists; no carbonates are present. In Falls Brook the upper reaches were more acid, richer in aluminum, ammonia, and nitrate, and diminished in alkali and alkaline earth cations, total fluoride, silica, and polyphenols, compared with the lower reaches. Sulfate and chloride were constant. A study of the aluminum chemistry of the stream showed that the upper reaches contained more inorganic monomeric aluminum and less organically complexed aluminum than the lower reaches. Evidence suggested that neutralization of acid rain occurs by a two-step chemical reaction. First, strong acids are rapidly but incompletely neutralized by dissolution of a reactive aluminum phase in the soil zone. Waters rich in Al with pH 4.7-5.2 are produced. Total acidity, including both hydrogen ion and Al acidity, is then slowly neutralized by basic cations released by decomposition of silicate minerals. Most of the neutralization is accomplished within first and second order basins. (Cassar-FRC)
W82-03641

CHARACTERIZATION OF A CONTAMINANT PLUME IN GROUND WATER, MEREDOSIA, ILLINOIS,
Illinois State Water Survey, Champaign.
T. G. Naymik, and M. J. Barcelona.
Ground Water, Vol 19, No 5, p 517-526, September/October, 1981. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Ammonia, *Solute transport, *Groundwater pollution, *Plumes, Nitrates, Fertilizers, Model studies, Path of pollutants, Fate of pollutants, Meredosia, Illinois, Nitrification, Oxidation.

A numerical solute transport model was used to characterize the dynamics of a dissolved inorganic fertilizer plume in a shallow sand and gravel aquifer. The source of the pollution was inorganic fertilizers in an uncovered bin located on a property adjacent to a liquid ammonia fertilizer distribution terminal. Within the plume, ammonia concentrations were 285-2100 mg per liter; nitrate concentrations were 570-1885 mg per liter. Sulfate, K, Cl, PO4, and Fe levels were above background, but Ca and Mg levels were well below background levels. The plume was in a steady-state condition, having begun 3 years prior to the survey. Simulations suggested that the pollutant would be naturally flushed within 420 days once the fertilizer pile was removed. Chemical equilibrium calculations show that Ca solubility is controlled by phosphate and carbonate equilibria. The most significant removal mechanism for ammonia from the groundwater is oxidation by acclimated nitrifying bacteria. (Cassar-FRC)
W82-03645

MOVEMENT OF CADMIUM AND WATER IN SPLIT-ROOT WHEAT PLANTS,
Oklahoma State Univ., Stillwater. Dept. of Agronomy.
M. B. Kirkham.
Soil Science, Vol 129, No 6, p 339-344, 1980. 2 Fig, 3 Tab, 16 Ref.

Descriptors: Capillarity, *Nutrients, Capillary capacity, *Capillary water, Soil water, *Wheat, *Cadmium, Ion transport, Roots, Path of pollutants.

The water status of wheat plants, cadmium content of plants, and soil water content were measured over a period of 50 days. Water was effectively transferred from the roots in the nutrient solution into roots in the unwatered soil, since the latter remained wet during the 50 days of the study. It is suggested that water was probably moved by capillary action from the solution side into the soil side. The part of the roots exposed to the air looked dry, which suggested that the water moved inside the roots, either along the cell wall surface or inside the cells. High concentrations of cadmium were found in the leaves of plants with roots split between uncontaminated soil and soil with cadmium. High concentrations of cadmium were found in the roots not exposed to cadmium. This suggests that cadmium was taken up by roots exposed to cadmium, transported to the shoots, and then transported down the plant to roots not so exposed. If all water had moved directly from one side of the root zone to the other through the crown and had bypassed the shoots, high cadmium concentrations would not have been noted in the shoots. These findings suggest that roots in a poor environment may be kept alive by roots of the same system growing near water in a water table or other body of water. Cultivars could be selected that might transfer more water and ions than other cultivars. (Baker-FRC)
W82-03662

DETOXICATION OF ZINC AND CADMIUM BY THE FRESHWATER PROTOZOAN TETRAHYMENA PYROFORMIS. I. THE EFFECT OF WATER HARDNESS,
Queen Elizabeth Coll., London (England).
For primary bibliographic entry see Field 5C.
W82-03678

THE CASE FOR THE PROTECTION OF MANGROVE SWAMPS: GEOCHEMICAL CONSIDERATIONS,
Adelaide Univ. (Australia). Centre for Environmental Studies.
P. Harbison.
Search, Vol 12, No 8, p 273-276, 1981. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Mangrove swamps, *Metals, Adsorption, Acidity, Swamps, Temperature effects, Aquatic life, Estuarine environment, Industrial wastes, Thermal pollution, Heated water, *Sediments, Fish.

A study was made from a geochemical aspect of the correlation between the sedimentary characteristics of the mangrove habitat and the factors which are known to influence the accumulation of heavy metals at the sediment/water interface. In South Africa several major industrial developments have been sited in or near mangrove swamps. The present recognition of the need to conserve these tidal swamps is based on their unique ecology, their contribution to the maintenance of fish populations, and their function in stabilizing the coastline. The most significant inputs to Gulf St. Vincent and Spencer Gulf are probably heated water, treated effluents, lead and zinc smelting wastes, hot water and seepage from fly ash, and steelworks discharge. A significant feature of all these discharges, apart from the heated water, is the content of heavy metals. Mangrove seedlings become established in sheltered, shallow, low-energy environments where the finest sediment fraction accumulates. This fraction contains high proportions of caly minerals, which present a very large surface area for the adsorption of heavy metals. The degree of adsorption or release of metals from fine particulates is highly pH-dependent. Changes in the pH of the water covering the mud surface in the mangrove swamp are strongly influenced by the photosynthetic activity of algal films. The most notorious features of mangrove mud, the black color and strong sulfide smell, are probably most relevant to its potential as a sink for heavy metals. The concentrations of metals in sediment samples collected during this study suggest that the natural physical and chemical characteristics of mangrove swamps do favor the accumulation of heavy metals in sediment. Natural occurrences which may facilitate the release of metals from the mangrove mud could also have a synergistic effect on their toxicity to marine organisms. (Baker-FRC)
W82-03683

TRACE ELEMENTS IN THE HYDROLOGIC CYCLE OF A FOREST ECOSYTEM,
California Univ., Berkeley. Dept. of Plant and Soil Biology.
J. G. McColl.
Plant and Soil, Vol 62, No 3, p 337-349, 1981. 3 Fig, 4 Tab, 19 Ref.

Descriptors: *Forest soils, *Trace elements, *Fate of pollutants, *Soil water, Forest hydrology, Copper, Manganese, Iron, Zinc, Precipitation, Metals, Stemflow, Rainfall, Throughfall, Litter, Toxins, Heavy metals.

Levels of Cu, Fe, Mn, and Zn, sometimes considered toxins, in bulk atmospheric precipitation, throughfall, stemflow, and soil solutions at 10-, 15-, 25-, and 30-cm depths in a Eucalyptus globulus forest of California were measured after each main storm event during the 1974-75 wet season. Metal concentrations in litter and plant samples were also determined. The hydrologic cycles of Cu, Fe, and Zn were similar, but Mn behaved differently. Mn and Zn were found mostly on forest canopy due to dry deposition, while Cu and Fe input occurred mostly on forest canopy due to dry deposition, while Cu and Fe input occurred mostly in rain. Cu, Zn and Fe levels in the soil solution fluctuated with downward movement of wetting fronts and were negatively correlated with pH. Fe levels in soil solution were approximately 10 times greater than in stemflow and throughfall. For Cu and Zn, the corresponding relative differences were much less. Mn was taken up by plants to a greater extent than Cu, Zn, or Fe. Since precipitation contained low levels of Mn, the increases in Mn levels from precipitation to throughfall and stemflow were greater than those for Fe, Cu or Zn. Mn levels in soil solution were also negatively correlated with pH. Although Mn accumulates in soil during the dry summer, it is quickly flushed out by the early rains of the wet season. (Geiger-FRC)
W82-03690

SIMULATING COAL PILE RUNOFF AS A DESIGN TOOL,
P. B. Katz, and G. T. Brookman.
Power Engineering, Vol 85, No 11, p 95-96, November, 1981. 1 Fig.

Descriptors: *Water pollution sources, *Runoff, *Model studies, Mathematical models, Utilities, Coal, Simulation, Design criteria, Precipitation, Drainage, Computers, *Coal pile runoff, Water pollution control.

Overdesign of treatment systems and reduction of chemical costs are considered in the simulation of precipitation and coal pile drainage through the use of a newly developed model. Development of the coal pile runoff mathematical model began in 1977 upon completion of an EPA-funded runoff study at two power plants with coal storage. On completion of the modeling program, deficiencies were noted in simulating the following: storm erosion of material from the coal storage pile, stormwater percolation through the coal pile, and pyrite oxidation/acid production in the coal pile. Physical or chemical phenomena associated with coal piles were then studied to determine which were valuable in the characterization of coal pile drainage. These phenomena included precipitation, surface runoff/infiltration, pile percolation and moisture content, snowmelt, and groundwater infiltration. Chemical and physical reactions occurring in the coal pile and thus considered included pyrite oxidation/acid production, freeze-thaw factor, gully erosion and coal pile washoff. The purpose behind simulating coal pile drainage is to design systems to treat acid drainage before discharge. A model allows simulation of several average and worst-case rainfall conditions as well as a plan for coal piles not yet formed. The model is now undergoing calibration and will be ready for use by the utility industry during 1982. (Baker-FRC)
W82-03692

RETENTION AND FATE OF EXPERIMENTALLY ADDED MERCURY IN A MASSACHUSETTS SALT MARSH TREATED WITH SEWAGE SLUDGE,
Woods Hole Oceanographic Institution, MA.
R. J. Breteler, J. M. Teal, and I. Valiela.
Marine Environmental Research, Vol 5, No 3, p 211-225, 1981. 3 Fig, 4 Tab, 41 Ref.

Descriptors: *Salt marshes, *Mercury, Heavy metals, Marshes, Tidal marshes, Municipal wastes, Sludge, Land disposal, Chemical analysis, *Fate of pollutants, Massachusetts.

An adaptation and development of methods for the determination of total mercury in environmental samples is presented. The technique is accurate, reproducible and applicable for peaty sediments, plants and animal tissues. The experimental plots each contained three habitats, characterized by dominant vegetation types. Tall low marsh extended a few meters on each side of the tidal creeks, was flooded twice daily and was covered with a tall form of Spartina alterniflora. Short low marsh contained predominantly a dwarf growth form of Spartina alterniflora and was considered a transitional zone to high marsh, which was covered by tidal water only during spring tides and dominated by Spartina patens and Distichlis spicata. Various amounts of a heavy metal-containing dried sewage sludge were applied to these plots. The treatments resulted in elevation of mercury levels in the surface 5 cm of soil. Discrepancies in the bulk density of marsh sediments corresponded with interparticle spaces and detritus/mineral ratios in the peat matrix. Mass balance calculations showed that wetlands covered with tall Spartina alterniflora lost mercury considerably faster than higher marsh locations, which retained virtually all mercury added. The shortest half-life of mercury calculated was four years. Grain size analyses of peat and sewage sludge suggested that mercury in the higher intertidal range remained associated with sludge components. Biochemical and physical processes affecting the dissipation of mercury from creekside sediments are discussed. (Baker-FRC)
W82-03695

MERCURY IN COASTAL AND ESTUARINE SEDIMENTS OF THE NORTHEASTERN IRISH SEA,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
J. E. Rae, and S. R. Aston.
Marine Pollution Bulletin, Vol 12, No 11, p 367-371, November, 1981. 4 Fig, 2 Tab, 32 Ref.

Descriptors: *Mercury, *Sediments, Organic carbon, *Path of pollutants, *Irish Sea, Mersey Estuary, Wyre Estuary, United Kingdom, Metals, Heavy metals, Industrial wastes, Chemical wastes, Water pollution sources, *Estuaries.

Surface sediments from the Wyre and Mersey estuaries contained 0.1-29.0 and 0.1-8.8 micrograms mercury per g, respectively. Sediments on the nearby Irish Sea coast had lower Hg levels, 0.1-0.4 micrograms per g. Both estuaries receive effluents from chlor-alkali plants. Hg concentrations were highly correlated with percent total oreganic carbon and percent of the < 63 microns grain size fraction of sediments. (Cassar-FRC)
W82-03696

CADMIUM IN AN AQUATIC ECOSYSTEM,
New York Univ., NY. Dept. of Environmental Medicine.
For primary bibliographic entry see Field 5A.
W82-03724

MOISTURE MOVEMENT IN SOILS IN THE VICINITY OF WASTE DISPOSAL SITES,
Texas Univ. at Austin.
For primary bibliographic entry see Field 2G.
W82-03728

THE FATE OF POLLUTANTS IN THE VADOSE ZONE, MONITORING METHODS AND CASE STUDIES,
Arizona Water Resources Research Center, Tuscon.
L. G. Wilson.
In: Proceedings of the Thirteenth Biennial Conference on Ground Water, Irvine, September 14-15, 1981. California Water Resources Center, University of California, Davis, Report No 53, November, 1981. p 128-154. 3 Fig, 6 Tab, 39 Ref.

Descriptors: *Vadose water, *Monitoring, *Water analysis, *Soil water table, *Sampling, Water pollution prevention, Water pollution sources, Groundwater movement, Infiltration, Deep percolation, Seepage, Root zone, Saturation zone, Lysimeters, *Fate of pollutants.

The vadose zone is important as a conduit and reservoir of liquids and liquid-borne pollutants. Monitoring in this zone can provide an early warning of pollutant movement. This paper reviews the processes operating in the vadose zone which affect pollutant mobility, describes common techniques of water quality monitoring in the vadose zone, and presents three case studies of vadose zone monitoring. The main processes to attenuate pollutant movement include biological, physical and physiochemical reactions, such as precipitation, surface reactions, chemical degradation, pH effects, oxidation-reduction effects, volatilization, and specific adsorption. Specific adsorption ap-

pears to be the most important process in retarding pollutant movement, particularly metals. The physiochemical processes that mobilize pollutants are dissolution and leaching of salts, cation exchange, oxidation-reduction, and pH effects. Organic matter, such as chelated metals, also causes certain pollutants to move in the vadose zone. Methods for monitoring pollutant flow include direct methods, such as resistivity techniques. Three methods are available for sampling in deeper regions of the vadose zone: solids sampling, suction lysimeters, and perched groundwater sampling. One case study in Illinois used lysimeters to show how pollutants had been attenuated. Another study in Arizona showed that pollutants were en route to the water table, and a third study, also in Arizona, showed that the groundwater system had already been impacted. (Atkins-Omniplan)
W82-03735

DUTCH DUMPS,
C. Schuuring.
Nature, Vol 289, No 5796, p 340, January 29, 1981.

Descriptors: *Chemical wastes, *Waste dumps, *Toxicity, Public health, Groundwater pollution, Drinking water, Industrial wastes, Agricultural chemicals, *Netherlands.

In the Netherlands, 3000 dumps containing chemical wastes have been identified, 500 of which are a recognized threat to public health. The Volgermeerpolder, a marshy area 5 miles from the center of Amsterdam, was found to contain about 10,000 drums of chemical wastes from a 2,4,5-T factory. This pollution scandal, among others, prompted a national inventory of chemical waste sites. The latest problem was when small amounts of methyl bromide were found in the drinking water in the horticultural area between the Hague and Rotterdam. The chemical is used to disinfect the soil at an estimated rate of 2000 tons/year, and the poison apparently seeped through the PVC tubes used for private water distribution. Public water companies have now been made responsible for private water supplies. (Small-FRC)
W82-03738

5C. Effects Of Pollution

OBSERVATIONS ON INFECTIONS ASSOCIATED WITH SOUTH WALES NATURAL WATERS,
University Hospital of Wales, Cardiff. Regional Public Health Lab.
R. W. S. Harvey, and T. H. Price.
Journal of Applied Bacteriology, Vol 51, No 2, p 369-374, October, 1981. 18 Ref.

Descriptors: *Infection, *Surface water, *Human diseases, Pathology, Diseases, Typhoid fever, Wales.

Cases of human disease related to exposure to contaminated surface waters in South Wales were identified through a central reporting system. During the summers of 1927-30 several persons who bathed in Roath Park Lake in Cardiff developed a papular dermatitis caused by skin penetration by the larvae of Carcaria ocellata found in the lake water. Roath Park Lake was treated with copper sulfate to destroy the snails which were the intermediate host of the larvae, but complaints of swimmers itch soon recurred and the lake was eventually closed to swimmers. Infections due to Leptospira icterohaemorrhagiae were diagnosed in the period 1940-1980. Of the 66 persons infected, 27 worked in coal mining, 9 were agricultural workers or small holders, 11 had contact with natural water and 3 were sewer workers. Of those with a history of contact with untreated waters, 9 had been immersed in a stream, pond, river or moat and two were fishermen. Two of those who immersed died of leptospirosis. Typhoid fever was diagnosed in one boy who had drunk water from the Morfa Brook. A young girl also developed typhoid and admitted to playing beside a stream near her house and placing her hands in the running water. In 1946, 48 proven infections of paratyphoid B fever were diagnosed. The cause was traced to a creamery whose supply of water came from a river grossly contaminated with sewage from towns higher up the valley. An outbreak of anthrax in cattle grazing in a field where river dredging spoils had been placed was not satisfactorily explained. (Baker-FRC)
W82-03409

THE CHEMISTRY AND FISHERY STATUS OF ACID LAKES IN NORWAY AND THEIR RELATIONSHIP TO EUROPEAN SULPHUR EMISSIONS,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
D. J. A. Brown, and K. Sadler.
Journal of Applied Ecology, Vol 18, No 2, p 433-441, August, 1981. 7 Fig, 12 Ref.

Descriptors: *Lakes, *Fisheries, *Acidic water, Water pollution effects, Acid rain, Air pollution, Sulfates, Sulfur, *Norway, Hydrogen ion concentration, *Sulfur emissions.

The effect of reducing sulfur emissions on the fish populations in southern Norway lakes (below 63 degrees North latitude) is estimated by analyzing the data of Wright and Snekvik (1978). This includes full chemical analyses of the water and fishery status of 471 lakes above 200 m elevation. In this group of lakes 48% have no fish, 43% are sparsely populated, and 9% have good populations. Regression analysis indicated that the pH and excess (non-sea) sulfate concentration were correlated, with a slope of 0.225. Assuming that the excess sulfate is largely derived from the combustion of fossil fuels, a 50% reduction in European sulfur emissions would increase pH by 0.2 units. This would improve the fishery status in lakes with pH above 4.9 (9% of all lakes). No improvement would take place in the 67% of lakes in the pH range 4.3-4.9, where pH and fish status are independent. Lakes north of the severely-impacted region would not be expected to improve in fishery status following a reduction in sulfur emissions. (Cassar-FRC)
W82-03418

OUTBREAKS OF WATERBORNE DISEASE IN THE UNITED STATES: 1971-1978,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5B.
W82-03430

CARCINOGENESIS OF SYNTHETIC ORGANIC CHEMICALS IN DRINKING WATER,
National Cancer Inst., Bethesda, MD. Div. of Cancer Cause and Prevention.
H. F. Kraybill.
Journal of the American Water Works Association, Vol 73, No 7, p 370-372, July, 1981. 2 Tab, 9 Ref.

Descriptors: *Carcinogens, *Drinking water, *Bioassay, Research priorities, Chemical wastes, Municipal water, Public health, Environmental effects, Water pollution effects.

The quantification of risk assessment of synthetic organic chemicals in drinking water by five experimental approaches is discussed. Seven hundred and sixty five organic chemicals have been detected in drinking water; of these, 43 are recognized or suspected carcinogens, 56 are mutagenic, and 18 are carcinogenic promoters. The recommended quantification procedures are: carcinogenesis bioassay with the use of rodents on concentrated water samples before and after GAC treatment, synthetic drinking water samples, in vivo bioassays for carcinogenesis and mutagenesis of samples of drinking water concentrates, use of large populations of rodents as control groups in multiple locations that use municipal water supplies, and the use of fish as an animal model to assess carcinogenic activity of a wide spectrum of municipal drinking water samples before and after GAC treatment. Thus, emphasis should be given to experimental approaches which can support epidemiologic studies and provide better leads for population studies. (Small-FRC)
W82-03433

WILL THE WORLD FACE UP TO ITS EVER-WORSENING ENVIRONMENTAL PROBLEMS.
For primary bibliographic entry see Field 4C.
W82-03459

EFFECTS OF SOME REPRESENTATIVE PETROLEUM REFINERY EFFLUENT COMPOUNDS ON PHOTOSYNTHESIS AND GROWTH OF NATURAL MARINE PHYTOPLANKTON ASSEMBLAGES: PART I--CRESOLS,
Scripps Institution of Oceanography, La Jolla, CA.
W. H. Thomas, S. S. Rossi, and D. L. R. Seibert.
Marine Environmental Research, Vol 4, No 3, p 203-215, 1980-81. 6 Fig, 1 Tab, 21 Ref.

Descriptors: *Oil pollution, *Cresols, *Phytoplankton, Growth rates, Toxicity, *Water pollution effects, Organic compounds, Aromatic compounds, Diatoms, Dinoflagellates, Algae, Marine algae, Photosynthesis.

Cresols inhibited growth of natural marine phytoplankton from Scripps Pier, La Jolla, California, at levels of 100 micrograms per liter where dinoflagellates were predominant and greater than 10,000 micrograms per liter where diatoms prevailed. Half-maximal photosynthesis concentrations were 10,000 micrograms per liter and 20,000 micrograms per liter, respectively. However, the reverse was true when the algae were studied in cultures. In a longer term experiment with natural algae, there was a 2-day growth lag at 8,500 micrograms per liter, but the algae recovered and grew at rates similar to controls. Complete growth inhibition occurred at 88,000 micrograms per liter in this experiment, during which diatoms grew and dinoflagellates and microflagellates disappeared. Cresols decreased with time, being degraded by bacteria and absorbed by the algae. (Cassar-FRC)
W82-03470

CHLORINATION OF DRINKING WATER AND PREGNANCY OUTCOMES IN NEW YORK VILLAGES, 1968-1977,
Columbia Univ., New York.
L. L. Rausch.
PhD Thesis, 1980. 198 p, 16 Fig, 11 Tab, 205 Ref, 3 Map, 6 Exhib, Append. University Microfilm International, Ann Arbor, MI; Order No GAX81-05095.

Descriptors: *Water quality, *Water treatment, *Chlorination, *Public health, Groundwater, Surface water, *Drinking water, Infection, Statistics, Mortality, Comparison studies, Nonchlorinated water, New York, Pregnancies.

Pregnancy outcomes in 1968-1977 were compared in three sets of predominantly white New York villages--one set using nonchlorinated ground water, one set using chlorinated ground water and one set using chlorinated surface water--closely matched according to geographic location and population size. Rates for prematurely terminated late fetal deaths and neonatal deaths were significantly higher in the villages using nonchlorinated water, despite the absence of a significant association involving gestational age or birthweight given gestational age. The relationship, occurring primarily in the northern part of the state, persisted when several maternal and health care factors were controlled, and was similar for both sexes. A significant interaction involving season was found, with the advantage of chlorination being most pronounced in the late spring and early summer. These findings were interpreted to be consistent with an effect of an unidentified waterborne infectious agent, which was eliminated by chlorination. Rates of anencephaly were found to be significantly higher in villages using surface water, in which organic by-products of chlorination are formed, than in villages using ground water, in which the presence of such compounds is negligible. Unfortunately, sample sizes were too small to permit further analysis. (Sinha-OEIS)
W82-03506

NEUROCHEMICAL AND PHYSIOLOGICAL CHANGES IN A TELEOST FISH INDUCED BY

EXPOSURE TO THE WATER SOLUBLE FRACTION OF SOUTH LOUISIANA CRUDE OIL OR ITS TOXIC AROMATIC COMPONENTS,
Tulane Univ., New Orleans, LA. Dept. of Biology.
L. C. Russel.
PhD Thesis, 1980. 67 p, 4 Fig, 3 Tab, 69 Ref. University Microfilm International, Ann Arbor, MI; Order No GAX81-09922.

Descriptors: *Oil pollution, *Water pollution effects, *Fish, *Toxicity, South Louisiana crude oil, *Physiology, Aromatic components, Water soluble fraction(WSF), Teleost fish, Fundulus grandus.

The brains of the Gulf killifish, Fundulus grandis, accumulate naphthalenes when this fish is exposed to sublethal concentrations of the water soluble fraction (WSF) of South Louisiana Crude oil, naphthalene or 3,6-dimethylnaphthalene. After 24 hr, the naphthalenes become localized mainly in the prosencephalon and nyelencephalon, the two more external brain regions. The opercular breathing rate is reduced by exposure to the WSF or pure naphthalenes, maximum change occurring 3-6 hr after exposure. The opercular breathing rate is increased by intraperitoneal injection of 1-DOPA and decreased by intraperitoneal injection of reserpine. The pigment in the melanophores of killifish becomes significantly more dispersed after exposure to sublethal concentrations of the WSF or pure naphthalenes. Intraperitoneal injection of 1-DOPA induces melanophore pigment aggregation. Melanophore dispersion is induced by intraperitoneal injection of reserpine. The mean DA concentration in the brains of killifish became reduced by a 24 hr exposure to the sublethal WSF or pure naphthalenes. The mean DA level in the brains of killifish increases after injection of 1-DOPA, and decreases following injection of reserpine. The volatine aromatic hydrocarbons of the WSF may, like reserpine, affect the brain DA level of fish by exerting a toxic action upon the DA-containing storage granules. The breathing rate and degree of melanophore dispersion are related to the level of DA in the brains of Gulf killifish. The preceding data and the discussion thereof are an attempt to provide greater perspective in the overall assessment of the hazards of petroleum pollution in the marine environment. (Sinha-OEIS)
W82-03511

HEALTH AND SAFETY OF WASTEWATER TREATMENT PLANT PERSONNEL,
Oklahoma Univ. Health Sciences Center, Oklahoma City.
For primary bibliographic entry see Field 5D.
W82-03535

PRODUCTION AND DECOMPOSITION OF ORGANIC MATTER AND BACTERIOPLANKTON UNDER EUTROPHICATION CONDITIONS,
Akademiya Nauk SSSR, Moscow. Inst. Biologii Vnutrennykh Vod.
A. K. Stolbunov.
Water Resources, Vol 8, No 1, p 71-84, January/February, 1981. 1 Fig, 8 Tab, 27 Ref. Translated from Vodnye Resursy, No 1, p 140-155, January/February, 1981.

Descriptors: *Organic matter, *Eutrophication, *Thermal pollution, Reservoirs, *USSR, *Ivankovo Reservoir, Bacteria, Primary productivity, Productivity, Macrophytes, Aquatic plants, Biological oxygen demand, Shallow water, Heated water, Powerplants, *Water pollution effects, Water quality, Nutrients, Nonpoint pollution sources.

The eutrophic state of Ivankovo Reservoir, one of the oldest on the Volga River, USSR, was investigated by determining BOD, primary production, decomposition of organic matter, bacterial production, total number of bacteria, and saprophytic bacteria at 15 sites representing shallow, deep, heated, and polluted water. On the whole the reservoir was classified as mesoeutrophic. Most of the eutrophic sections of the reservoir were in shallow bays and waters heated by thermal powerplant discharges. In the Shosha pool, average depth 1.7m, a vast macrophyte stand produces 35,000 tons of organic matter annually. Some areas of the reservoir are relatively non-eutrophic due to self-purification. Although input of nutrients from sewage is expected to decrease, nonpoint source pollution from agricultural land will become more significant. This will produce an increase in higher aquatic vegetation and organic matter, detrimental to water quality. (Cassar-FRC)
W82-03575

TEMPERATURE EFFECTS ON HYDRAZINE TOXICITY TO BLUEGILLS,
Air Force Aerospace Medical Research Lab., Wright-Patterson AFB, OH.
T. P. Hunt, J. W. Fisher, J. M. Livingston, and M. E. Putnam.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 588-595, November, 1981. 2 Fig, 4 Tab, 11 Ref.

Descriptors: *Toxicity, *Fish, *Hydrazine, *Bluegills, Water pollution effects, Temperature effects, Nitrogen compounds.

The acute toxicity of hydrazine to bluegill, Lepomis macrochirus, was determined at 10, 15.5 and 21C. LC50's (mg per liter) were as follows for exposures of 1, 6, 24, and 96 hours, respectively: 10C--265, 12.9, 7.7, and 1.6; 15.5C--68.4, 12.4, 3.8, and 1.0; 21C--37.7, 3.8, 1.7, and 1.2. The toxicity of hydrazine depended inversely upon the length of exposure according to a constant LC50 times exposure duration relationship. Toxicity increased with temperature, but water temperature played a more important role for the 1, 6, and 24 hour exposures than for the 96 hour exposures. (Cassar-FRC)
W82-03603

A SIMPLE, RAPID BIOASSAY FOR DETECTING EFFECTS OF POLLUTANTS ON BACTERIA,
Oregon State Univ., Corvallis. Dept. of Microbiology.
N. J. Bauer, R. J. Seidler, and M. D. Knittel.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 577-582, November, 1981. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Toxicity, *Bacteria, *Bioassay, *Water pollution effects, Microbiological studies, Dissolved oxygen, Oxygen depletion, Heavy metals, Metals, Pesticides, Herbicides, Pollutant identification, Cadmium, Copper, Nickel, Sulfates, Diuron, Pentachlorophenol, Atrazine, Trichloroacetic acid, Dimethylformamide, Diazinon.

A screening bioassay test was developed to predict toxicity of hazardous substances. The test measures the kinetics of dissolved oxygen depletion by a mixed microbial population following exposure to a pollutant. Results are available in 40 min. The pollutant is incubated in a bacteria-nutrient broth mixture, and dissolved oxygen depletion is monitored every 2 min. Results are expressed as the ratio of the test T50 (time of 50% dissolved oxygen depletion) to the control T50. This ratio is the activity quotient, which is 1.00 if the pollutant has no toxic effect, $>$ 1.00 if stimulatory, and $<$ 1.00 if toxic (0.8-0.94 designates slightly toxic; 0.5-0.79, moderately toxic; and $<$ 0.5, extremely toxic). The activity coefficients of compounds during a brief exposure (about 30 min) and an extended exposure (22 hours) were as follows: Cd (5 ppm), 0.27 and 0.11; Cu (5 ppm), 0.43 and 0.24; Ni (5 ppm), 0.51 and 0.54; sulfate (50 ppm), 1.00 for both; diuron (40 ppm), 0.83 and 0.56; pentachlorophenol (14 ppm), 0.86 and 0.36; atrazine (33 ppm), 1.0 and 0.76; trichloroacetic acid (50 ppm), 0.96 and 0.88; dimethylformamide (50 ppm), 0.95 and 0.85; and diazinon (40 ppm), 1.01 and 1.03. The rapid, simple dissolved oxygen uptake assay system requires minor capital expenditures. (Cassar-FRC)
W82-03604

EVIDENCE FOR METAL POISONING IN ACUTE DEATHS OF LARGE RED DRUM (SCIAENOPS OCELLATA),
Florida Univ., Gainesville. Coll. of Veterinary Medicine.
P. T. Cardeilhac, C. F. Simpson, F. H. White, N. Thompson, and W. E. Carr.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 639-644, November, 1981. 2 Tab, 14 Ref.

Descriptors: *Toxicity, *Metals, *Fishkill, Water pollution effects, Heavy metals, Copper, Drum, Zinc, Arsenic, Chromium, Cadmium, Mercury, Gills, Mortality, Indian River Lagoon, *Florida, *Red drum.

Metal intoxication was the cause of a fishkill (about 100 large red drum) in the Indian River and Mosquito Lagoon, Florida, June 14-July 7, 1980. Pesticides, biological toxins, and hypoxia were eliminated as possible causes. Analysis of stomach contents showed that Cu, Zn, and As and possibly Cd, Hg, and Cr were responsible for poisoning the fish, which were feeding almost exclusively on large blue crabs at the time of the kill. Metal concentrations in tissues of moribund red drum showed the following increases (in ppm) over controls: Cu--liver 45, gill 8, kidney 10, and stomach contents 2; Zn--liver 132, gill 54, kidney 4, and stomach contents 25; As--liver 5.4; gill 0.5, kidney none, and stomach contents 0.3. Livers of the diseased fish showed increases over controls for Cr, Cd, and Hg of 59, 8.2, and 2.5 ppm, respectively. Gills on the affected fish were edematous and coated with mucus. This condition produced an electrolyte imbalance with dramatic increases of serum Na, Cl, and K. (Cassar-FRC)
W82-03606

HEMOSIDERIN GRANULES: CYTOTOXIC RESPONSE TO ARSENIC EXPOSURE IN CHANNEL CATFISH,
Texas Univ. at Austin. Dept. of Pharmacology.
E.M. B. Sorensen, and N. K. R. Smith.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 645-653, November, 1981. 7 Fig, 19 Ref.

Descriptors: *Arsenic, *Toxicity, *Fish, Water pollution effects, Metals, Channel catfish, Heavy metals, Liver, Hemosiderosis, *Catfish, Sublethal effects.

Adult channel catfish, Ictalurus punctatus, exposed to 15 ppm arsenic as sodium arsenate for 6 months, showed electron microscopic evidence of liver changes. Hepatocytes from affected catfish livers showed proliferated rough endoplasmic reticulum, smaller nuclei, and a great increase in size and number of hemosiderin granules. The probable cause of the hemosiderosis is hemolytic jaundice. Arsenic was found in the hemosiderin granules, suggesting storage of a toxic material in a less toxic, insoluble form. (Cassar-FRC)
W82-03607

RESPONSE OF TROUT HEPATIC MIXED-FUNCTION OXIDASES TO EXPERIMENTAL FEEDING OF TEN KNOWN OR POSSIBLE CHLORINATED ENVIRONMENTAL CONTAMINANTS,
Dalhousie Univ., Halifax (Nova Scotia). Coll. of Pharmacy.
F. C. P. Law, and R. F. Addison.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 605-609, November, 1981. 1 Tab, 15 Ref.

Descriptors: *Chlorinated hydrocarbons, *Toxicity, *Fish, Bioassay, Liver, *Trout, Enzymes, Sublethal effects, Polychlorinated biphenyls, Organic compounds, Aromatic compounds, Water pollution effects.

Brook trout, Salvelinus fontinalis, fed sublethal amounts of chlorinated organic compounds (to produce whole body concentrations of 200 micrograms per g) were studied for effects on mixed-function oxidases. The most useful indicators of MFO induction were benz(a)pyrene hydroxylase and ethoxycoumarin O-de-ethylase activities. Three potential polychlorinated biphenyl replacements (isopropyl chlorobiphenyls mixture, chlorinated naphthalenes mixture, and 1,2,4-trichlorobenzene) produced no apparent MFO induction in the fish. Varying responses were seen in the other materials tested: polychlorinated biphenyl, mirex,

hexachlorobenzene, hexachlorobutadiene, octachlorostyrene, and a brominated biphenyl based fire retardant. (Cassar-FRC)
W82-03609

KRAFT PULP MILL EFFLUENT AND SEDIMENT CAN RETARD DEVELOPMENT AND LYSE SEA URCHIN EGGS,
Shizuoka Coll. of Pharmaceutical Sciences (Japan). Lab. of Health Sciences.
N. Kinae, T. Hashizume, T. Makita, I. Tomita, and I. Kimura.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 616-623, November, 1981. 1 Fig, 5 Tab, 17 Ref.

Descriptors: *Sea urchins, *Pulp and paper industry, *Toxicity, Water pollution effects, *Industrial wastewater, Eggs, Kraft mills, Shinguu River, Japan, Invertebrates, Marine animals, Organic compounds, Effluents, Sediments, Carcinogens, Sea urchin eggs.

Sea urchin eggs, Anthocidaris crassispina, were exposed to ether extracts of kraft pulp mill effluent and sediments from the estuary of the Shinguu River, Japan. The extracts were separated into five fractions: neutral, acidic, basic, amphoteric, and phenolic. Of the effluent extracts the basic fraction was most toxic, decreasing the egg fertilization to 35% at 10 ppm concentration. Of the sediment extracts the acidic fraction was most toxic, decreasing fertilization of eggs to 25% at 10 ppm. All five fractions retarded development of eggs at 1 to 10 ppm and caused cytolysis at 100 ppm. Slime controller was the most toxic of nine pulp and paper industry materials similarly tested. (Cassar-FRC)
W82-03610

AN IN SITU STUDY OF CADMIUM AND MERCURY STRESS IN THE PLANKTON COMMUNITY OF LAKE 382, EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO,
Argonne National Lab., IL.
J. S. Marshall, J. I. Parker, D. L. Mellinger, and S. G. Lawrence.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, 2 Fig, 4 Tab, 28 Ref.

Descriptors: *Water pollution effects, *Cadmium, *Mercury, *Plankton, Heavy metals, Inorganic compounds, Zooplankton, Phytoplankton, *Lakes, Species diversity, Ecological effects, Species composition, Crustaceans, Aquatic populations, Aquatic productivity, Primary productivity, *Ontario.

In the Experimental Lakes Area (ELA) Lake 382 of Northwestern Ontario, in situ experiments were carried out in 28-liter carboys at various depths to assess the effects of inorganic Hg and Cd on planktonic communities. Over a three-week period, additions of 9 nanomoles Cd/liter or 10 nanomoles Hg/liter caused significant reductions of crustacean zooplankton density, zooplankton community similarity and diversity, and levels of dissolved oxygen. Primary productivity of phytoplankton was decreased by additions of 20 nanomoles Hg/liter, but not by 10 nanomoles Hg/liter. The toxicities of inorganic Hg and Cd to lake plankton were similar on a molar concentration basis. At molar concentrations above 2 nanomoles/liter, Hg and Cd may cause significant changes in lake plankton communities. Close agreement of results was found for Cd levels over 0.2 micrograms/liter in experiments on ELA lakes and on Lake Michigan. However, toxic levels of inorganic Hg have not yet been documented in lake waters. (Geiger-FRC)
W82-03612

DETOXICATION OF ZINC AND CADMIUM BY THE FRESHWATER PROTOZOAN TETRAHYMENA PYROFORMIS. I. THE EFFECT OF WATER HARDNESS,
Queen Elizabeth Coll., London (England).
G. Chapman, and S. Dunlop.
Environmental Research, Vol 26, No 1, p 81-86, 1981. 2 Fig, 21 Ref.

Descriptors: *Zinc, *Cadmium, *Toxicity, Heavy metals, Metals, Calcium, Magnesium, Protozoa, Water pollution effects, Absorption, Path of pollutants, Metabolism, Chemical interactions, Hardness.

Zinc and cadmium toxicity to the protozoan Tetrahymena pyriformis were reduced in the presence of Ca and Mg ions in concentrations characteristic of very hard water. The 8-hour LC50 values (in ppm) for Zn were: < 1 ppm with no Ca or Mg, 14 with 500 ppm Ca, 28 with 500 ppm Mg, and 24 with 500 ppm Ca + Mg. LC50 values for Cd were generally lower: < 1 ppm with no Ca or Mg, 16 with 500 ppm Ca, 9 with 500 ppm Mg, and 19 with 500 ppm Ca + Mg. Experiments with Zn65 indicated that the uptake of this element from sublethal concentrations, 0.1 ppm, by 1 million cells were reduced from 0.5 micrograms per liter to 0.1 micrograms per liter by adding 500 ppm Ca alone or 500 ppm Ca + Mg. Mg alone was about half as effective in reducing toxicity. The mechanism of protection against Zn and Cd is thought to be reduced uptake at the cell membrane in the presence of Ca and Mg. (Cassar-FRC)
W82-03678

THE CASE FOR THE PROTECTION OF MANGROVE SWAMPS: GEOCHEMICAL CONSIDERATIONS,
Adelaide Univ. (Australia). Centre for Environmental Studies.
For primary bibliographic entry see Field 5B.
W82-03683

EFFECT OF WATERS OF VARIOUS HARDNESS ON THE CARDIOVASCULAR SYSTEM. (O VLIYANII VOD RAZNOI ZHESTKOSTI NA SERDECHNO SOSUDISTUYU SISTEMU),
Nauchno-Issledovatelskii Inst. Gigieny, Moscow (USSR).
A. I. Levin, Yu Novikov, S. I. Plitman, Yu. A. Noarov, and K. O. Lastochkina.
Gigiena i Sanitariia, No 10, p 16-19, October, 1981. 2 Tab, 8 Ref. (English Summary).

Descriptors: *Water pollution effects, *Magnesium, *Calcium, *Drinking water, *Human physiology, *Hardness, Phsiological ecology, Public health, Potable water, Human pathology, Human population, Minerals.

Studies were made on the cardiovascular systems of women aged 20-49 years living in three study areas and a control area supplied with drinking water of different degrees of hardness and varying amounts of calcium and magnesium. Abnormal ausculatory sounds were observed more frequently in women in two of the three study areas. Electrocardiographic studies revealed a significantly decreased QRS voltage in study areas A and C. Sinus arrhythmia and reduced S-T interval were found more frequently in study areas A and B. Women from the three study areas also displayed electrocardiographic signs indicative of changes in electrophysiologic processes in the myocardium. A high positive correlation was discovered between the level of magnesium in drinking water and the amplitude of wave I. A high negative correlation was found between the overall hardness of the water, the quantity of magnesium in it, and the frequenncy of maximum arterial blood pressure in the danger zone in women aged 20-29 years. (Geiger-FRC)
W82-03699

FAUNAL ASSEMBLAGES OF SOME SALINE LAKES NEAR MARCHAGEE, WESTERN AUSTRALIA,
Western Australia Univ., Nedlands. Dept. of Surgery.
For primary bibliographic entry see Field 2H.
W82-03704

DEVELOPMENT OF HEALTH EFFECTS CRITERIA FOR FRESHWATER BATHING BEACHES BY USE OF MICROBIAL INDICATORS,
Oklahoma Univ., Norman.
For primary bibliographic entry see Field 5A.
W82-03730

5D. Waste Treatment Processes

MANAGING VEGETATION IN WASTEWATER APPLICATION,
Michigan State Univ., East Lansing. Inst. of Water Research.
F. M. D'Itri.
BioCycle, Vol 22, No 6, p 30-35, November-December, 1981.

Descriptors: *Land disposal, *Wastewater treatment, *Wastewater renovation, Vegetation regrowth, Vegetation establishment, Vegetation, Corn, Forest management, *Spray irrigation.

The proper selection and management of vegetation for the efficient renovation of municipal wastewater by slow rate, overland flow, or spray irrigation systems is discussed. The selection of land treatment relative to other methods depends on the size of the community and the expertise of local system operators, as well as the cost, quantity and type of land available. Once land treatment has been determined to be feasible, guidelines for operating and managing the system can be produced. Protecting the groundwater is a primary consideration. Spray irrigation has been the most common land treatment method in the north central United States. The responses of crops to slow rate wastewater application have been quite similar on all types of soil. The limited amount of leachate which does occur may contain nitrate concentrations greater than 10 mg/liter as nitrogen due to the absence of plant growth. Row crops such as corn are attractive, since their potential of economic return is high. However, the limited root biomass early in the season and limited period of rapid nutrient uptake can present problems. The tradeoff between good renovation and a cash return can best be attained by mixing corn and forage crops. Land application has proven excellent for phosphorus and nitrogen removal. Harvesting schedules are important for forage crops. Maximum crop yields and nutrient removals result when forage grasses are harvested three or more times per year with the first harvest in late May or early June. Forestry studies indicate that coniferous and hardwood forest ecosystems can be effective living filters to improve the quality of wastewater by removing the nutrients. Forest productivity was also increased by this process. (Baker-FRC)
W82-03401

PHOSPHORUS REDUCTION STUDIES,
A. V. Gray.
Water Pollution Control, Vol 80, No 3, p 333-340, 1981. 5 Fig, 20 Ref.

Descriptors: *Phosphorus removal, *Wastewater treatment, Phosphorus, Filtration, Lime, Effluents, Industrial wastes, Domestic wastes, Municipal wastes.

Waterborne phosphorus enters sewage treatment plants from three main sources. The domestic contribution is split between the phosphorus originating from detergents and that from human excreta. The third source is industrial. Influent sewage contains a mixture of phosphorus compounds including dissolved orthophosphate, dissolved and particulate organic phosphates, inorganic condensed phosphates, and particulate inorganic phosphates, either precipitated or adsorbed onto other solids. Detergent formulations include polyphosphates as builders and water conditioners such as sodium tripolyphosphate, trisodium phosphate, tetrasodium pyrophosphate, sodium tetraphosphate, and sodium hexametaphosphate. The use of the split-effluent lime process to achieve phosphorous reduction was investigated by treatment of secondary effluent at biological filtration works. Laboratory studies were conducted to determine the dose rates, floc settlement characteristics, and the size of flocculation tank required so that a pilot-scale plant could be made. Results indicate that different lime doses were required, depending on the character of the sewage. Higher alkalinity sewage required higher lime doses to attain the same degree of phosphorus removal, as the process appeared to be pH dependent. Best removal was obtained after the precipitation of magnesium hydroxide at pH

greater than 11.3. By using filtration, lower lime doses could be used, and consequently a less alkaline effluent would result, requiring less neutralization prior to dischare. Much lower sludge volumes would also result. The split-effluent practice was then tried, which splits the sewage into two unequal parts, adding the total lime to the smaller volume and mixing, followed by reuniting the parts and mixing again. This resulted in considerable monetary savings during neutralization steps. (Baker-FRC)
W82-03426

PRIMARY SEDIMENTATION OF SEWAGE,
Lanchester Polytechnic, Coventry (England). Dept. of Civil Engineering.
J. A. Anderson.
Water Pollution Control, Vol 80, No 3, p 413-420, 1981. 8 Fig, 2 Tab, 12 Ref.

Descriptors: *Sedimentation, Flow rates, *Suspended solids, Overflow, Flow, *Wastewater treatment, Primary wastewater treatment, *Settling tanks.

A new method is proposed which assesses the efficiency of primary sedimentation tanks in terms of the removal of settleable solids. From the results of tests on experimental and pilot-scale tanks and from data obtained for full-scale works, the non-settleable solids appear to be constant for a given works, being independent of both influent suspended solids concentrations and retention period or overflow rate. Factors which affect sedimentation tank design and performance include hydraulic behavior, inlet design, shape and depth of tank, effluent weir design and associated floc paths, design and operation of sludge scraper, arrangements for sludge storage and removal, variations in the influent flow rate and suspended solids, and physical, chemical and biological characteristics of the influent. While the effect of increasing the hydraulic loading at a particular works is difficult to predict accurately, it is suggested that for typical retention periods of around 6 hr, the effect of doubling the flow rate will probably cause only a slight reduction in efficiency of removal of settleable solids. It is suggested that the design of future sedimentation tanks be based on existing tanks whose efficiency of removal of settleable solids is high, possibly with increased overflow rates. (Baker-FRC)
W82-03429

ELIMINATION OF TOXIC METALS FROM WASTEWATER BY AN INTEGRATED WASTEWATER TREATMENT/WATER RECLAMATION,
National Inst. for Water Research, Pretoria (South Africa).
R. Smith, and S. G. Wiechers.
Water S A, Vol 7, No 2, p 65-70, April, 1981. 1 Fig, 8 Tab, 15 Ref.

Descriptors: *Water reuse, *Metals, *Toxicity, Denitrification, Clarification, *Wastewater treatment, Filtration, Chlorination, Activated carbon, Drinking water, Municipal wastes.

A pilot-scale integrated wastewater treatment/water reclamation plant was investigated for the removal of eight toxic metals: arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. The plant includes combinations of biological and chemical-physical processes, and is operated on screened raw sewage at a flow of 2.4 cu m/hr. Treatment stages include denitrification, chemical mixing and clarification, nitrification and secondary clarification, filtration, active carbon adsorption, and final chlorination. Solutions containing the metals were fed into the system, and with the exception of barium, concentrations of all metals were reduced to values below their respective atomic absorption detection limits at or before the secondary clarification stage. Cadmium, chromium, mercury, and arsenic were completely removed at the chemical mixing/clarification stages. The active carbon treatment stage was also effective in removing metals. A system such as this could be used to prepare high quality water directly from raw sewage. (Small-FRC)
W82-03439

INNOVATIONS IN WASTEWATER TREATMENT PROCESSES: DESIGN BACKGROUND DOCUMENTS DUE IN 1981,
K. A. Godfrey, Jr.
Civil Engineering (New York), Vol 50, No 9, p 67-69, September, 1980.

Descriptors: *Publications, *Design criteria, Environmental Protection Agency, American Society of Civil Engineers, Water Pollution Control Federation, *Wastewater treatment, Organizations, Professional societies, *Water treatment facilities.

The EPA, the American Society of Civil Engineers, and the Water Pollution Control Federation are publishing the 'Design Information Series' to encourage use of innovative ideas in wastewater treatment process design. Typical subjects among the first of about 25 40-60 page reports are dry weather peaking, suspended-growth biological treatment performance, fixed-film biological treatment performance, mechanical reliability, and sidestreams. In addition, the 3 groups plan design documents of their own. the WPCF has scheduled 10 manuals for fall 1980 (sludge thickening, energy conservation, pumping stations, pretreatment, sewer design, sampling, etc.). The ASCE has 4 manuals of practice in preparation on environmental assessment, sewer design, nonpoint sources of pollution, and water treatment plant design management. The EPA also has several more documents on innovative technologies. (Cassar-FRC)
W82-03453

REPUBLIC STEEL RECYCLING 80% OF STEEL-MILL WASTEWATER.
Civil Engineering (New York), Vol 50, No 6, p 102-104, June, 1980. 1 Fig.

Descriptors: *Steel industry, *Industrial wastewater, Water reuse, *Wastewater treatment, Water pollution control, Recycling.

A $19 million 14 mgd wastewater treatment plant at Republic Steel's Canton, Ohio, plant makes possible an 80% wastewater reuse. The technology for coagulation and clarification is not unique, but the idea of a single, central wastewater treatment plant and its underground distribution system is unusual. The plant is constructed on pile foundations on poor soil in a flood plain. To further reduce treatment requirements, scale on steel bars is removed by mechanical grinding rather than by pickling liquor. A small percentage of makeup water prevents damage to the pipes from the high-Ca-Mg groundwater. (Cassar-FRC)
W82-03454

TAMPA'S HOOKERS POINT AWT PLANT WORKING WELL.
Civil Engineering (New York), Vol 51, No 6, p 56-58, June, 1981.

Descriptors: *Advanced wastewater treatment, *Design considerations, *Tampa, Florida, Wastewater treatment, Suspended solids, Biological oxygen demand, Dissolved oxygen, Oxygen, Nitrogen, Dentrification.

The Hookers Point advanced wastewater treatment plant near Tampa, Florida is described. The plant incorporates a number of innovations to achieve a high level of removal of BOD, suspended solids, and nitrogen from the wastewater. It is also designed to remove phosphorus. The receiving waters (Hillsborough River and Bay) appear to be improving. The plant has a flexibility of process which permits operation with a capacity of 60 mgd as an advanced wastewater treatment facility, or with a capacity of 120 mgd as a secondary treatment facility. The operation depends on how many of the oxygen reactors are devoted to carbonaceous BOD removal, and how many to conversion of ammonia to nitrate. There was no need for new primary clarifiers to be constructed, as the existing clarifiers were used to handle part of the raw wastewater, the rest being channeled directly to the oxygen reactors. Provision was made for the use of brewery waste as a food for bacteria prior to nitrification at some time in the future, replacing methanol. Total reactor tankage for BPD removal, nitrification, and denitrification is less than 3.5 hrs retention time. The filtration and denitrification processes were combined into one step. A low capital cost phosphate removal system is another of the innovations, whereby phosphate is removed by adding a precipitating chemical to the reactor. The final innovation is the use of low-energy sludge drying beds, in which a polymer is added to the sludge just before it flows into the bed. (Baker-FRC)
W82-03455

OUTLOOK FOR WATER AND WASTEWATER SYSTEMS, PROCESSES, AND EQUIPMENT: COMMENTS FROM CH2M HILL, CORVALLIS, OR,
J. W. Filbert.
Water/Engineering and Management, Vol 128, No 3, p 62, March, 1981.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Management planning, Equipment, Projections, Federal regulations.

A major problem in the area of water and wastewater treatment is the poor quality of much of the equipment being utilized, as a result of Environmental Protection Agency (EPA) 'or equal' requirements for procurement. Although the EPA's new equipment prequalification procedure may bring significant improvement to the quality of major process equipment and systems supplied, the quality of most minor equipment and systems incorporated into plants will not be affected. The increasing realization that much of the equipment delivered to new construction is of poor quality should lead to revision of the regulations to permit owners to use cost-competitive but owner-selected process equipment procurement procedures. Systems and equipment brought on the market in the future should feature quality as well as performance and should become more popular. The demand for sludge thickening, conditioning, and dewatering equipment should also increase. Continued expansion and quality improvement in the instrumentation and control systems field as related to wastewater treatment is also expected. (Carroll-FRC)
W82-03463

UTILIZATION OF THE ALGAE OOCYSTIS SP. FOR TERTIARY TREATMENT OF WASTEWATERS - II. EFFECT OF PRELIMINARY CONDITIONING OF THE CELLS IN A CYCLOSTAT ON THEIR NITROGEN UPTAKE RATE DURING PROLONGED INCUBATIONS (IN FRENCH),
Laval Univ., Quebec. Center for Nutrition Studies.
J. de la Noue, G. A. Picard, J. P. Piette, and C. Kirouac.
Water Research, Vol 14, No 8, p 1125-1130, August, 1980. 5 Tab, 16 Ref. (English Summary).

Descriptors: *Wastewater treatment, *Algae, *Nutrients, Nitrogen, Tertiary wastewater treatment, Oocystis, Aquaculture, Kinetics.

Ammonia uptake rates by Oocystis sp. were compared in the preconditioning phase (phase I) and in the incubation phase (phase II) of wastewater treatment. In the preconditioning phase, the cells are conditioned with wastewater which has previously been subjected to primary and secondary treatment with activated sludge and diluted to give a low nitrogen concentration (50 micromolar ammonium nitrogen). In the incubation phase, the cells are inoculated into a more or less dilute secondary effluent, rich in nitrogen and phosphorus nutrients. This comparison was made in order to determine whether rapid uptake of nitrogen nutrients by 'starved' cells occurs during the prolonged incubations required for complete removal of nutrient from wastewater. At equilibrium in Phase I the phytoplankton cells had a relatively constant ammonium nitrogen uptake rate per cell. This rate varied in the six water stocks with different inorganic nutrient concentrations, but it was always 2.4-6 times lower than the uptake rate by these cells in Phase II. At the end of Phase II (12 hr) the cell nitrogen content was up to 3.5 times higher than the initial content. The results show

the potential of algal tertiary treatment for the purification of wastewater as well as for production of a biomass. (Hertzoff-FRC)
W82-03464

OUTLOOK FOR WATER AND WASTEWATER SYSTEMS, PROCESSES, AND EQUIPMENT: COMMENTS FROM MALCOLM PIRNIE, INC., WHITE PLAINS, NY,
For primary bibliographic entry see Field 6A.
W82-03474

DESIGNING AN ENERGY-EFFICIENT WASTEWATER TREATMENT PLANT,
Water and Sewage Works, Vol 127, No 2, p 40-44, February, 1980. 7 Fig, 16 Tab.

Descriptors: *Water treatment facilities, *Design criteria, *Pumps, Wastewater treatment, Waste heat, Efficiency, Energy loss, Energy transfer, Energy conservation, Costs.

Various heat pump options believed to represent energy-saving methods for wastewater treatment plants are considered. These options include pumping heat from final effluent to heat the building by installing an evaporator section in the chlorine contact chamber. Annual savings would be about $860 in natural gas purchases, and the operating cost would be $760 annually. The pumping of heat from final effluent to heat the aeration tanks is also considered, along with pumping heat from compressor room to heat the main building, digester gas heating of primary digester and main building, digester gas fueling of an internal combustion engine directly coupled to an air compressor in the diffused aeration plant, and digester-gas fueling of the engine-generator set in the mechanical aeration plant. A summary of the various energy conservation methods and their costs and benefits is presented. (Baker-FRC)
W82-03477

DESIGNING FOR COARSE SAND FILTRATION SYSTEMS,
J. G. Walters.
Water and Sewage Works, Vol 127, No 2, p 28, February, 1980. 2 Fig.

Descriptors: *Filtration, *Design criteria, *Wastewater treatment, *Sand filters, Filters, Backwash, Pilot plants.

Backwash considerations when designing coarse sand filtration systems are discussed. Solids must be removed from the top of the filter to the wash water waste gullet. The dirty water is removed by means of wash troughs or a backwash weir and surface sweep. Additional horizontal velocity is imparted to the surface of the filter so that the solids flushed from the media can be efficiently swept into the gullet without wash troughs. During the filtering cycle wastewater flows into the filter bay through the surface sweep distributor. During backwash, unfiltered wastewater continues through the distributor at a rate of 2-3 Gpm/sq ft and sweeps dirty water toward the wastewater gullet. Loss of media from the system can be controlled by keeping the flow of air and water at such a rate as to avoid surges. Use of pilot plant studies may be profitable, but these must be carefully designed to yield constructive and useful results. (Baker-FRC)
W82-03478

MICROORGANISM INVENTORY IN ACTIVATED SLUDGE CONTROL,
Montgomery County Sanitary Dept., Dayton, OH.
R. R. Himebaugh.
Water/Engineering and Management, Vol REF, No HB, p R26-R30, 1981. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Activated sludge process, *Monitoring, Wastewater treatment, Protozoa, Bacteria, Sludge, Monitoring, *Microorganisms, Flagellates, Rotifers, Montgomery County, *Ohio.

A quick, easy method of assessing the biological status of the activated sludge system in operation at a wastewater treatment plant needs to be designed and incorporated as a daily parameter in plant operation. At the Montgomery County Western Regional Wastewater Treatment Plant, several levels of data are collected that allow immediate assessment of the activated sludge bio-system. Since this plant operates both a carbonaceous and a nitrogenous activated sludge process, it is highly susceptible to toxic material, especially in the nitrification process. In this assessment system, protozoa types are classified into four groups, and rotifers are included as a fifth group. Included in each general group are more specific organism types. A percentage of microorganism group types is calculated from a sample count. When 100 or 50 organisms total are tallied the count ends, and each group's percentage of the total organisms is calculated. This inventory provides information concerning the decrease in biomass due to toxic materials and also the changes occurring in the maturity or evolution of the microorganism population. The five groups are so defined that group 1 organisms are very primitive protozoa which would indicate an immature sludge, while group 5 organisms are a more highly evolved, mature group. Information on the biomass changes can be followed on a time graph. After collecting a sufficient amount of data, a break point can be established which signals to the operators of the system that some imbalance or toxicity in the system has occurred. Using this protozoa count parameter one measures the living condition of the activated sludge, thus allowing predictable information for operating the wastewater treatment plant, which is not offered by most other physical and chemical parameters currently being monitored. (Baker-FRC)
W82-03483

CONTROL OF THE ACTIVATED SLUDGE PROCESS,
New Hampshire Dept. of Highways.
R. P. Carter.
Water/Engineering and Management (Reference Number) p R131-2, R135-6, 1981. 2 Fig, 7 Ref.

Descriptors: *Activated sludge, *Mathematical models, Wastewater, *Microorganisms, *Aeration, *Wastewater treatment, Solids, Solid wastes, Digested sludge, Biodegradation, Effluent standards, Activated sludge process.

With the 'Al West' method of cotrolling the activated sludge process, it is difficult to maintain a steady state condition. This is attributed to the nature of the clarifier sludge flow demand formula, which does not take wasting into account and therefore leads to cycles of overwasting of the sludge. A mathematical solution to this problem is presented. It is based on the use of a centrifuge test to measure volume rather than weight as a control parameter. Such a test should provide a more accurate estimate of the number of microorganisms in the activated sludge system. (Titus-FRC)
W82-03499

IMPROVING TREATMENT WORKS EFFICIENCY.
Civil Engineering (London), p 45, October, 1981. 1 Fig.

Descriptors: *Control systems, *Monitoring, *Computers, Automation, *Wastewater facilities, Electric power production, Methane, *United Kingdom, Wastewater treatment.

A computer-based monitoring and control system is described which will control general plant functions and the generation of electrical power from processed sewage gas. This distributed system uses a series of microprocessors to carry out data collection and control functions which are linked to a PDP-11/23 microcomputer. Software comprises a set of modular programs to carry out data collection and analysis routines as well as the appropriate display, alarm, and control functions. The generators at the station run on a dual-fuel mixture of collected sludge gases (methane) and 10% diesel fuel. The system is being installed at the Wessex Water Authority's Avonmouth recovery facility. (Small-FRC)
W82-03500

TRIHALOMETHANE FORMATION FROM HUMIC MATERIALS IN CHLORINATED RECLAIMED WASTEWATER,
California Univ., Berkeley.
M. G. Richard.
PhD Thesis, June, 1980. 416 p, 51 Fig, 73 Tab, 217 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-29557.

Descriptors: *Wastewater treatment, *Secondary wastewater treatment, *Reclaimed water, *Chlorination, Halogens, Bromides, *Organic compounds, Disinfection, Humic acids, Microorganisms, Potable water, Public health, *Trihalomethane(THM), San Francisco Bay area.

Trihalomethane (THM) and other unidentified volatile halogenated organic compounds were formed in relatively large concentrations under conditions of normal wastewater disinfection in nine secondary and post-secondary wastewater effluents examined. Chlorination of treated wastewater under drinking water conditions as would occur in wastewater reclamation, to yield a long-term free chlorine residual, resulted in substantial increases in THM formation over that observed in chlorinated drinking waters. The formation of volatile halogenated organic compounds in chlorinated treated wastewater also differed from chlorinated drinking water in the following important ways: Bromine-substituted THM compounds predominated in most chlorinated treated wastewaters examined, accounting for from 50 to 89% of total THM products, while chloroform predominated in most chlorinated drinking waters. Non-THM volatile halogenated organic compounds were formed in much higher concentrations in chlorinated treated wastewater compared with chlorinated drinking waters. It is concluded that the use of treated reclaimed wastewater as a source of potable water supply, either directly or indirectly due to water supply contamination, could increase human exposure to halogenated organic compounds, unless remedial action is taken. (Sinha-OEIS)
W82-03517

PROJECT REPORT, PLANNING AND DESIGN DEVELOPMENT KAW POINT WASTEWATER TREATMENT PLANT, KANSAS CITY, KANSAS,
S Kansas Univ., Lawrence. School of Engineering and Architecture.
J. C. Roth.
PhD Thesis, April, 1980. 332 p, 23 Fig, 9 Tab, 10 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-26740.

Descriptors: *Engineering, *Wastewater treatment facilities, *Design criteria, Municipal wastewater, Industrial wastes, Secondary wastewater treatment, *Kansas City, Kansas.

This report is a systematic documentation of the inception, design development, design, and finally, the partial construction of additions to Municipal Wastewater Treatment Plant No. 1 (Kaw Point) in Kansas City, Kansas. The report demonstrates the relationship between engineering practices and non-engineering influences on a large-scale, multidisciplined treatment plant design project. The subject is the design of secondary treatment facilities for an existing 36 million gallons per day primary wastewater treatment plant. A brief description of the three-phase project is presented in a table. Background information is provided on the community and existing facilities to aid in understanding specific reported actions. (Sinha-OEIS)
W82-03525

HEALTH AND SAFETY OF WASTEWATER TREATMENT PLANT PERSONNEL,
Oklahoma Univ. Health Sciences Center, Oklahoma City.
T. J. Carpenter.
PhD, Thesis, 1980. 97 p, 11 Fig, 6 Tab, 65 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-17740.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Safety, Hazards, Public health, Microor-

ganisms, Environmental effects, *Gases, Vapors, Occupational health hazards.

This investigation was designed to identify and evaluate the occupational health hazards of the total plant environment of a municipally operated wastewater treatment facility. During the 24-month study, a 25-mgd trickling filter plant was subjected to a comprehensive industrial hygiene investigation followed by a detailed analysis of the health hazard considered to be the most significant. It was concluded that the facility studied and potentially all others having similar unit operations, contained many serious physical, chemical, and biological hazards to the health and safety of those employed in and around such facilities. The following summary of findings is offered: Violations of good safety practices were numerous and included improper location of chlorine gas masks, improperly mounted and outdated fire extinguishers, unprotected pit openings, insufficient ventilation, unsecured cylinders of compressed gas, exposed v-belts, inadequate showering and eating facilities, and poor general housekeeping. Exposure to physical hazards ranged from noise levels in the blower room and in the engine room to heat stress. Hazardous gases and vapors were frequently detected. Marked increases in airborne microorganisms were observed in both in-door and ambient environments. The alarmingly high counts observed in enclosed buildings where sewage was agitated was considered to be the most significant health hazard observed during the study. (Sinha-OEIS)
W82-03535

DESIGN MANUAL; ONSITE WASTEWATER TREATMENT AND DISPOSAL SYSTEMS,
Rural Systems Engineering, Madison, WI.
R. J. Otis, W. C. Boyle, E. V. Clements, and C. J. Schmidt.
Environmental Protection Agency Report EPA-625/1-80-012, October, 1980. 412 p, 86 Fig, 82 Tab, 204 Ref. 1 Append.

Descriptors: *Design criteria, *Wastewater treatment, *Wastewater disposal, *Domestic wastes, Septic tanks, Intermittent filters, Nutrient removal, Disinfection, Recycling, Water pollution prevention, Groundwater pollution.

Approximately 18 million housing units, or 25% of all housing units in the United States, dispose of their wastewater using onsite wastewater treatment and disposal systems. These systems include a variety of components and configurations, the most common being the septic tank/soil absorption system. The number of onsite systems is increasing, with about one-half million new systems being installed each year. This manual provides information on generic types of onsite wastewater treatment and disposal systems, and is intended for those involved in the design, construction, operation, maintenance, and regulation of onsite systems. Treatment methods considered include: septic tanks; intermittent sand filters; aerobic treatment units; disinfection; nutrient removal; waste segregation and recycle systems. Disposal methods include: subsurface soil absorption; evaporation systems; and outfall to surface waters. Groundwater and surface water pollution are major environmental considerations when onsite systems are used. All wastewater treatment and disposal systems must be designed, constructed, operated, and maintained to prevent degradation of both groundwater and surface water quality. Secondary criteria for selection of a design are cost and ease of operating and maintaining the system. The fate of any residuals resulting from the treatment and disposal system must be considered in the selection process. (Moore-SRC)
W82-03538

UNSLAKED LIME - ITS DIRECT USE IN PHOSPHORUS REMOVAL PROCESSES.
Environmental Protection Service, Burlington (Ontario). Wastewater Technology Center.
Canada-Ontario Agreement on Great Lakes Water Quality Research Report No 105, 1980, 24 p. 6 Fig, 14 Tab, 18 Ref.

Descriptors: *Phosphorus removal, *Wastewater treatment, *Lime, *Nitrification, *Hydration, Quicklime, Slaker, Experimental methods, Sewage, Sludge production, Slaking reactor, *Great Lakes, Water quality control, Canada.

This study, designed to evaluate the use of quicklime for phosphorus removal, was supported under the Canada-Ontario Agreement on Great Lakes Water Quality. The study was carried out in a 1.5 L/s (20 lgpm) pilot plant operated at the Wastewater Technology Centre. The experimental work occurred over a seven month period from October, 1972 to April, 1973. The study determined that quicklime may be used in place of hydrated lime without an increase in the lime requirement provided that the lime slaking temperature was within 60 to 82 degrees C and the water/quicklime ratio (weight basis) 6 to 10 at a slaking reactor detention time range of 5 to 50 minutes. A quicklime feed preparation system was developed and the full scale system design is presented. (WATDOC)
W82-03539

OZONE FOR MUNICIPAL WASTEWATER DISINFECTION,
Oklahoma State Univ., Stillwater. School of Civil Engineering.
E. L. Stover.
Water/Engineering and Management, Vol 128, No 10, p 74-76, 1981. 3 Fig, 2 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Disinfection, *Ozonation, Ozone, Costs, Water quality, Potable water, Municipal wastewater.

Applications of ozone for wastewater treatment are few at the present time in European countries. In the United States, disinfection of treated municipal wastewater is common practice and substantial research has gone into methods using ozone for this purpose. Absorbed ozone doses in the range of 4 to 8 mg/liter have been found to achieve disinfection levels of 200 fecal coliforms per 100 ml. At the operating plants tertiary and/or advanced wastewater treatment is accomplished prior to ozonation, resulting in clean effluents with suspended solids concentrations usually less than 10 mg/liter. Electrical power is the major source of operating expense for ozone production and application. About 10% of the total power required can be accounted for in the amount of gas produced, with the remainder consumed by air handling, air preparation, and waste heat production. Utilization of ozone must be accomplished as efficiently as possible since the production process is relatively expensive. The key element of an efficient process is the reactor or ozone contacting system. This must be designed for optimal ozone transfer or utilization by employing established principles of mass transfer and reaction kinetics. The amount of absorbed ozone required to achieve disinfection will vary from plant to plant depending on the characteristics of the influent. (Baker-FRC)
W82-03559

TREATING INFILTRATION AT ITS SOURCE REDUCES CAPITAL COSTS.
Water and Pollution Control, Vol 119, No 10, p 16, October, 1981.

Descriptors: *Sanitary engineering, *Storm seepage, *Sewer infiltration, *Overflow, *Capital costs, Wastewater treatment, Sanitation, Sewer systems, Storm runoff, Storm sewers, Future planning, Pipes, Decision making, Monitoring, Wastewater facilities.

To cope with problems caused by the infiltration of groundwater or stormwater runoff into sanitary sewers, Knox Martin Kretch Limited (KMKL) has devised a priority order for systematic investigations to help municipalities solve their sewer overflow difficulties. First, available flow analysis must be verified by field measurements and pump metering. When designing new sewage treatment facilities, negligence in treating the causes of unnecessary infiltration could result in increased capital costs of between $4320 and $7200/gallon/min of unnecessary flow. Gravity sewer systems should be divided into subcatchments for metering purposes. Areas of high infiltration should be monitored by closed circuit television to inspect pipe conditions and ensure the quality of joints. Dye and smoke testing of subcatchments can identify areas where catchbasins, roof leaders and perhaps storm sewers are cross connected to the sanitary system. Such flaws should be corrected to avoid damage to public areas and private residences as a result of sewer flow and gas backup. These investigations will point to areas where improvements may be made for future construction and where the emphasis of financing should be placed. (Geiger-FRC)
W82-03564

TEXANS CLAIM BREAKTHROUGH IN ANAEROBIC WASTE TREATMENT,
T. Davey.
Water and Pollution Control, Vol 119, No 10, p 10, October, 1981.

Descriptors: *Methane, *Anaerobic bacteria, *Activated sludge, Wastewater management, Sludge, Wastewater facilities, *Wastewater treatment, Effluent limitations, *Industrial wastes, Carbon dioxide, Anaerobic treatment, Bacteria, Oxidation process.

A new low energy anaerobic process for treating high strength industrial wastes has been developed. It is suitable for wastes from the petrochemical, pulp and paper, and food and beverage industries. The method offers a return on investment by reducing the amount of chemicals and electricity required in the treatment. It produces one tenth of the sludge produced by conventional methods and lessens the space requirements. Gas produced in the anaerobic reactor is compressed and burned. The effluent produced by the anaerobic reactor is separated, and aerobic bacteria are added and then returned to aeration basins. The aeration system is monitored by an automatic control system which maintains filter temperature at 99 degrees Farenheit and pH at 7. (Titus-FRC)
W82-03565

CLOSED CYCLE SYSTEM A BOON TO PULP AND PAPER INDUSTRY,
T. Davey.
Water and Pollution Control, Vol 119, No 10, p 18-19, October, 1981. 1 Tab.

Descriptors: *Water pollution control, *Pulp wastes, *Kraft mill wastes, *Pulp and paper industry, Industrial wastes, Bleaching wastes, Chlorine, Steam, Scaling, Corrosion, Biochemical oxygen demand, Capital costs, Estimated costs, Effluent limitations, Wastewater treatment, *Ontario.

A closed-cycle system for bleached kraft pulp mills has been developed and installed in Ontario, Canada. The design of this system includes: (1) reduced mill water usage, (2) countercurrent recycle of bleaching process streams, (3) 70 percent substitution of chlorine dioxide for chlorine in the first bleaching stage, (4) evaporation of the cooking liquor until the sodium chloride crystallizes and is removed by filtration, and (5) steam stripping of foul evaporator condensates. The mill has achieved its goal of reducing the need for mill effluent treatment. There is no apparent difference in the quality of the bleached pulp compared to the conventional process. Full closure of the water cycle has not yet been achieved because of corrosion in the recovery boiler superheater. Trials with full closure gave BOD5 discharges of 7.5 kg/tonne of pulp, compared to the normal kraft mill effluent of 40 kg/tonne and the value for partial closure of 15.4 kg/tonne. (Titus-FRC)
W82-03566

A COMPREHENSIVE STUDY ON THE BIOLOGICAL TREATABILITIES OF PHENOL AND METHANOL--I. ANALYSIS OF BACTERIAL GROWTH AND SUBSTRATE REMOVAL KINETICS BY A STATISTICAL METHOD,
Korea Inst. of Science and Technology, Seoul.
J. W. Kim, M. J. Humenick, and N. E. Armstrong.
Water Research, Vol 15, No 11, p 1221-1231, November, 1981. 3 Fig, 5 Tab, 8 Ref.

Descriptors: *Bacteria, *Kinetics, *Oxidation, *Wastewater treatment, Phenol, Methyl alcohol, Statistical methods, Biological treatment, Substrates, Decomposition, Degradation, Biodegradation, *Industrial wastewater, Chemical wastewater.

A statistical method is developed for the evaluation of kinetic coefficients in biological wastewater treatment. Equations describe the bacterial growth and substrate removal kinetics. The Michaelis-Menten constant (Ks) and cell yield coefficient are not significantly dependent on temperature, but substrate removal coefficient and cell decay coefficient are closely dependent on temperature. Ks and cell yield coefficient are 236 + or - 70 mg per liter and 1.21 + or - 0.06 respectively for phenol and 2330 + or - 1410 mg per liter and 1.25 + or - 0.45 respectively for methanol, based on total organic carbon and volatile suspended solids. A formula is given for oxygen utilization rate. In this expression the coefficient for oxygen requirement per substrate utilized is 1.39 for phenol and 2.23 for methanol; the coefficient for oxygen requirement per unit biomass for endogenous respiration is 1.42 times cell decay coefficient for both substances, based on total organic carbon and volatile suspended solids. (Cassar-FRC)
W82-03567

A COMPREHENSIVE STUDY ON THE BIOLOGICAL TREATABILITIES OF PHENOL AND METHANOL--III. TREATMENT SYSTEM DESIGN,
Korea Inst. of Science and Technology, Seoul.
J. W. Kim, and N. E. Armstrong.
Water Research, Vol 15, No 11, p 1249-1257, November, 1981. 12 Fig, 2 Ref.

Descriptors: Kinetics, *Biological treatment, Design criteria, *Phenol, Oxidation, *Methanol, *Wastewater treatment, Decomposition, Degradation, *Industrial wastewater, Chemical wastewater.

Systems for biological treatment of wastewater can be designed using mass balance equations for continuous stirred tank reactors (CSTR) and numerical methods and batch kinetic diagrams for batch systems. Batch systems require less aeration time to achieve a given effluent quality than CSTR systems. The relative efficiency of the CSTR systems to that of the batch systems, based on aeration time, rapidly decreases as the influent to effluent quality ratio increases. For example, a relative efficiency of 0.7 is obtained for 10 mg per liter influent, 0.27 for 50 mg per liter influent, and 0.05 for 500 mg per liter influent in the case of phenol, with a desired effluent level of 5 mg per liter total organic carbon and 3000 mg per liter initial volatile suspended solids. (Cassar-FRC)
W82-03568

COMPREHENSIVE STUDY ON THE BIOLOGICAL TREATABILITIES OF PHENOL AND METHANOL--II. THE EFFECTS OF TEMPERATURE, PH, SALINITY AND NUTRIENTS,
Korea Inst. of Science and Technology, Seoul.
J. W. Kim, and N. E. Armstrong.
Water Research, Vol 15, No 11, p 1233-1247, November, 1981. 20 Fig, 7 Tab, 9 Ref.

Descriptors: *Bacteria, *Oxidation, Kinetics, *Wastewater treatment, Methyl alcohol, *Phenol, *Methanol, Temperature effects, Hydrogen ion concentration, Salinity, Biological treatment, Statistical methods, Nutrients, Metals, Nitrogen, Phosphorus, Decomposition, Degradation, Biodegradation, *Industrial wastewater, Chemical wastewater.

A statistical method developed in a previous study was used to investigate the effects of temperature, pH, salinity, and nutrients on biological decomposition of wastewater. The optimum pH range for bacterial growth was near neutral. With phenol the optimum pH range in fresh water was 6.5-8.0. As salinity increased, the optimum pH range was 6-7 at 5C, 6.5-8 at 21C, and 7-8.5 at 28C. With methanol in fresh water, the optimum was 8-9 at 5C, and 9 at higher temperatures. Increasing salinity narrowed the tolerable pH range. The endogenous respiration rate was closely related to the substrate utilization rate coefficient and was affected by pH, temperature, and salinity. In batch biological treatments of 770 mg per liter phenol and 1000 mg per liter methanol, as total organic carbon, N and P had no recognizable effects on the substrate utilization rate coefficient, but Fe(2+), Mg(2+), Mn(2+), and Zn(2+) showed a slightly perceptible effect on it. In phenol treatments the absence of extracellular N and P produced a greater cell yield, but the cells decayed more rapidly than normal cells. In natural systems pH had significant effects on the substrate decomposition rate. Phenol decomposition decreased the pH considerably, so that in low alkalinity waters the bacterial action was delayed. The initial pH of the water was the most important factor in decomposition of methanol, which did not affect pH. An average initial lag in decomposition of 8 hours was seen in 8 of 115 phenol tests and 9 hours for 31 of 66 methanol tests. This produced average aeration lags of 5 hours for phenol and 6 hours for methanol. (Cassar-FRC)
W82-03569

COLIFORM AND CHEMICAL OXYGEN DEMAND REMOVAL FROM MEATWORKS EFFLUENTS BY DIFFERENT TREATMENT PROCESSES,
Commonwealth Scientific and Industrial Research Organization, Sydney (Australia). Animal Research Labs.
S. P. Moodie, B. V. Kavanagh, and M. G. Smith.
Water Research, Vol 15, No 11, p 1259-1263, November, 1981. 1 Fig, 3 Tab, 19 Ref.

Descriptors: *Meat processing industry, *Bacteria, *Chemical oxygen demand, *Wastewater treatment, Coliforms, Aerobic bacteria, *Activated sludge process, Alum, Coagulation, Physicochemical treatment, *Lagoons, Trickling filters.

Meat processing plant wastewaters with high bacterial levels (about 50 million per ml total aerobes and about 20 million per ml total coliforms) were subjected to treatment with 4 processes. The lagoon system and activated sludge system were most efficient, removing 89% and 96% COD, respectively, and 71% and 96% suspended solids, respectively. Bacteria were reduced by factors of 10 to 100 for anaerobes and 1000 to 10,000 for coliforms. The physicochemical treatment (alum coagulation) and high rate trickling filtration were less effective. COD removals were 61% and 39%, respectively, and suspended solids removals, 88% and 59%, respectively. Physicochemical treatment reduced bacterial counts by 10 times. Trickling filter treatment had little effect on bacterial counts. (Cassar-FRC)
W82-03570

EFFECT OF SLIME STUCK INSIDE SAMPLING PIPINGS ON WATER QUALITY AND HOW TO REMOVE IT,
Hitachi Ltd., Yokohama (Japan). Production Engineering Research Lab.
Y. Hiratsuka, K. Odajima, and H. Kihana.
Water Science and Technology, Vol 13, No 8, p 69-74, 1981. 6 Fig, 1 Tab, 4 Ref.

Descriptors: *Slime, *Process control, *Maintenance, *Cleaning, *Pipelines, Wastewater facilities, Water treatment, Water quality standards, Process water, Monitoring, Water analysis, Materials engineering.

Slime sometimes becomes stuck inside the sampling pipes of water quality measuring equipment in water purification and wastewater treatment plants, affecting the analysis of such water quality process parameters as turbidity, residual chlorine, dissolved oxygen, total organic carbon, and ammoniacal nitrogen. Conventional mechanical or chemical means of pipe cleaning are usually inadequate for slime removal. Washing with hypochlorite was time consuming and interrupted routine measurements. With a cannon-ball shaped elastic pig, washing through bends and small pipings was difficult. A system for cleaning with a small sponge ball driven through the piping by clean water under pressure was devised. The sponge ball can easily clean bends, elbows and branches set in a zig-zag pattern. The automatic sponge device was tested in a water purification plant. Results proved this pipe cleaning system satisfactory for keeping water clean for process monitoring purposes. (Geiger-FRC)
W82-03585

TERTIARY WASTEWATER TREATMENT TO REMOVE NITROGEN COMPOUNDS IN AERATED OXIDATION PONDS,
Academy of Municipal Economy, Moscow (USSR).
L. I. Gyunter, E. V. Grebenevich, V. A. Vavilin, and V. B. Vasil'ev.
Water Resources, Vol 8, No 1, p 61-71, January/February, 1981. 4 Fig, 8 Ref. Translated from Vodnye Resursy, No 1, p 128-139, January/February, 1981.

Descriptors: *Tertiary wastewater treatment, *Algal growth, *Oxidation ponds, *Wastewater treatment, Ponds, Nitrogen compounds, Aeration, Temperature effects, Nutrients, Model studies, Light quality, Carbon dioxide.

Tertiary treatment of wastewaters in algal ponds was studied in the laboratory and with a model to determine the effects of illumination, temperature, concentration of nitrogen compounds, and aeration. Illumination was the main factor limiting algal development in aerated ponds. Nonlimiting factors were dissolved in organic nitrogen (never less than 0.5 mg per liter) and CO2 shortage. Temperature produced retardation of growth only at 5-9C. The model indicated that the effectiveness of the treatment process depended on depth of pond, flow velocity, temperature, and illumination. Little oxidation would take place in fall and winter in the middle latitudes of the USSR. A three-section pond is 10% more effective than a one-section pond. Algae must be removed as formed to prevent secondary pollution from mineralization of dead algae. (Cassar-FRC)
W82-03587

ELECTROPLATING WASTES: HISTORY AND CURRENT STATUS,
C. F. Gurnham, and L. A. Ganzel.
Industrial Finishing, Vol 57, No 11, p 14-17, November, 1981.

Descriptors: *Electroplating, *Metal-finishing wastes, *Industrial wastewater, *Wastewater treatment, Chromium, Cyanide, History, Ion exchange, Evaporation, Membrane processes, Chemical precipitation, Reverse osmosis, Ultrafiltration.

The electroplating industry has been active in pollution control since the mid-1940's. By 1949 several treatment systems were in use--chlorination of cyanides, barium sulfide for chromium reduction and precipitation and sulfuric acid treatment followed by aeration to disperse HCN into the air. During the 1950's a metals reclamation plant was in operation. Historically, electroplaters have followed a three-phase treatment program: (1) destruction of cyanide by alkaline chlorination, (2) reduction of chromates to trivalent Cr, and (3) metal precipitation of the combined streams. There are several newer technologies. Ion exchange processes are useful in metal recovery and to prolong plating bath life. Evaporation techniques produce water suitable for reuse but are energy intensive. Improved metal precipitation methods use sulfides, hydrosulfides, or xanthates of starch or cellulose. Membrane processes are continuous and have low operating costs. These include ultrafiltration, good for alkaline cleaning solutions; reverse oxmosis, which produces water for reuse and a concentrated solution return to the plating bath; and electrodialysis, for saline waters. Donnan dialysis, an experimental countercurrent process, uses the concentration gradient across the membrane as the driving force. (Cassar-FRC)
W82-03588

WASTEWATER TREATMENT PLANT FEATURES NEW TECHNOLOGY,
Wade, Trim and Associates, Taylor, MI.
M. L. Alexander.

Public Works, Vol 112, No 11, p 50-52, November, 1981. 2 Fig.

Descriptors: *Wastewater treatment, *Sludge, Construction, *Activated sludge process, *Aeration, Wastewater facilities, Flow, Infiltration, Incineration, Energy, Dewatering, Sludge drying, Sludge thickening, Polymers, Filtered wastewater, Bay City, *Michigan.

Design of an advanced sludge handling sewage treatment plant for Bangor Township, Bay City, Michigan, is discussed. The plant uses three special features: (1) a jet aeration system in the activated sludge process, (2) a membrane type plate and frame filter press to produce sludge cakes which are 50% dewatered, and (3) an incinerator designed to burn the sludge in an autogenous mode using sludge as an energy source. The incinerator can be turned on and off to save energy. During the first year of operation, the facility has performed successfully. Influent biological oxygen demand and suspended solids average 136 mg/liter and 174 mg/liter respectively. (Titus-FRC)
W82-03591

HOW DO YOU BUILD WHEN SEWERS ARE INADEQUATE,
Browne (Richard) Associates, Wayne, NJ.
N. K. Stegmann.
Public Works, Vol 112, No 11, p 74-75, November, 1981.

Descriptors: *Construction, *Sewers, *Municipal wastes, Planning, *Sewer systems, Management planning, *Wastewater facilities, Wastewater disposal, Wastewater treatment, Interceptor sewers, Main sewers, Flow, Sewer infiltration, Case studies, Wayne Township, *New Jersey.

Municipal problems related to an imposed sewer ban are discussed. The tax structure can be adversely affected if property cannot be developed. A domino effect can occur when shutdown of commercial or industrial development results in loss of potential jobs. Wayne Township in New Jersey has an imposed sewer ban. Developers are allowed to hook up to the Township sewer system if they agree to rehabilitate a portion of the sewer system, reducing infiltration. This program allows development to proceed and reduces the flow to the treatment plant without imposing additional tax burdens on the residents at large or waiting for federal funds. (Titus-FRC)
W82-03592

INLAND CONTAINER SAVES MONEY WITH ANAEROBIC-AEROBIC TREATMENT PLANT,
Inland Container Corp., Newport Mill, IN.
C. J. Priest.
Tappi, Vol 64, No 11, p 56-60, 1981. 7 Tab.

Descriptors: *Pulp and paper industry, *Wastewater treatment, *Aerobic treatment, Costs, *Anaerobic digestion, Industrial wastes, Water conservation, Indianapolis, Indiana.

A new 350 tons/day waste paper recycling mill was begun in 1973 at Indianapolis, Indiana. The mill was designed for low water usage. It utilizes one million gallons per day, or about 2,000 gals per ton. It is obtained from on-site wells and steam condensate. All of the water is used several times before it becomes effluent. There are a number of pieces of equipment designed into the mill for cleaning and recycling process water. The original plant was built using pilot studies and projections from older mills. The initial effluent system consisted of a one million gal/day Dorr-Oliver clarifier, a one million gal emergency sludge pond, two 5.5 million gal aeration basins, and two 3.3 million gal polishing (settling) basins. The two aeration basins each had two 60 hp stationary aerators. A Parshall flume was used to measure daily discharge to the river. The effluent system was begun using the aeration basins in parallel without nutrient addition. After a few months operation was improved by running the aeration basins in series. Shortly after start-up the BOD load began to exceed 9,000 lb/day and has continued to increase to the present levels of 15,000 to 24,000 lb/day. One solution to the effluent problem was an activated sludge plant. Another was a direct anaerobic treatment. A pilot study of anaerobic treatment was performed, with the result that Inland was allowed to pursue conversion to an anaerobic/aerobic system. Five items of critical importance to control of the system include volatile acids, alkalinity, pH, temperature, and organic and hydraulic loading. (Baker-FRC)
W82-03593

BIOLOGICAL KINETIC DESIGN FOR NITRIFICATION IN HIGH-STRENGTH INDUSTRIAL WASTEWATERS,
Weston (Roy E.), Inc., West Chester, PA.
M. Ramanathan, and E. L. Stover.
AIChe Symposium Series, Vol 77, No 209, p 295-303, 1981. 3 Fig, 5 Tab.

Descriptors: *Nitrification, *Industrial wastewater, *Ammonia, Chemical wastewater, Activated sludge process, Oxidation, Design criteria, Sludge, *Wastewater treatment, Biological treatment, Organic compounds, Nitrogen compounds.

A high-strength wastewater was used to obtain design data in a two-stage continuous flow, biological activated sludge system. The influent contained 15,000-25,000 mg per liter COD, 1,000-2,000 mg per liter total Kjeldahl nitrogen (TKN), and 100-300 mg per liter ammonia-nitrogen. Typical treated effluent contained 2,000-4,000 mg per liter COD, 500-1,500 mg per liter TKN, and 500-1,000 mg per liter ammonia after the first (carbonaceous) digestion stage and 2,000-4,000 mg per liter COD, 100-300 mg per liter TKN, < 5 mg per liter ammonia-N, and 500-1000 mg per liter nitrate-N. Design parameters for a 1 mgd facility are given. Wastewater containing up to 1,500 mg per liter TKN and 100 mg per liter ammonia-N can be successfully treated. The reaction kinetics for nitrification can be related to a concentration loading ratio based on TKN, and the ratio, in turn, to the ammonia oxidation rate coefficient. The organic nitrogen compound oxidation appeared to be the controlling reaction rather than biological nitrification. (Cassar-FRC)
W82-03597

PRODUCTION OF AMMONIA IN A PACKED-BED ANAEROBIC UPFLOW (ANFLOW) BIOREACTOR,
Tennessee Univ., Knoxville. Dept. of Civil Engineering.
D. C. M. Hines, D. W. Weeter, and R. K. Genung.
AIChE Symposium Series, Vol 77, No 209, p 286-294, 1981. 10 Fig, 5 Tab, 17 Ref.

Descriptors: *Ammonia, *Anaerobic digestion, *Organic loading, *Hydraulic loading, *Wastewater treatment, Nitrification, Methane, Packed beds, Volatile acids.

Effluent ammonia concentrations from anaerobic, upflow (ANFLOW) biological wastewater treatment systems were studied under organic loading rates of 0.43 to 3.50 kg per cu m per day, hydraulic loading rates of 0.0068 and 0.0136 liters per sq m per sec, and soluble COD concentrations of 750, 1500, and 3000 mg per liter. COD removals (87.5-94%) were linearly correlated with organic loading rates at a given hydraulic loading rate. The profiles of soluble COD and volatile acids levels showed distinct regions of complex organic breakdown, ammonia formation, and wastes stabilization. The zones shifted with changes in operating conditions. Methane production, about 0.4 cu m per kg of soluble COD removed, was insensitive to organic loading rates and hydraulic loading rates. Effluent ammonia concentrations (65-217 mg per liter) were correlated with influent soluble COD concentrations and organic loading rates for a given hydraulic loading rate. Ammonia production rates (1.1-5.2 g per day) were related to organic loading rates and were independent of hydraulic loading rates over the range studied. Residual effluent ammonia was effectively removed by an aerobic unit sized at about 5% of the volume of the ANFLOW reactor. (Cassar-FRC)
W82-03598

TREATABILITY AND PATHWAYS OF PRIORITY POLLUTANTS IN THE BIOLOGICAL WASTEWATER TREATMENT,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 5B.
W82-03599

CONTINUOUS ION EXCHANGE: DESIGN CALCULATIONS,
For primary bibliographic entry see Field 8C.
W82-03623

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY, VOLUME I; GENERAL.
Environmental Protection Agency, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 5B.
W82-03624

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY, VOL II: COKE MAKING SUBCATEGORY, SINTERING SUBCATEGORY, IRON MAKING SUBCATEGORY,
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 5B.
W82-03625

DEVELOPMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY VOL III: STEEL MAKING SUBCATEGORY, VACUUM DEGASSING SUBCATEGORY, CONTINUOUS CASTING SUBCATEGORY CONTINUOUS CASTING SUBCATEGORY,
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
Environmental Protection Agency Report EPA-440/1-80/024-b, December, 1980. 513 p, 90 Fig, 183 Tab.

Descriptors: *Steel industry, *Industrial wastes, *Water pollution sources, *Wastewater treatment, Effluents, Pollutants, Flow control, Toxicity, Metals, Fluorides, Oil, Grease, *Water pollution control, Costs, Heavy metals, Suspended solids, Standards.

This volume contains effluent limitation giuidelines for BPT, BCT and BAT as well as pretreatment standards for new and existing sources (PSNS and PSES) and new source performance standards for the steelmaking, vacuum degassing, and continuous casting subcategories of the steel industry. For the steelmaking category BPT and BAT effluent discharge limitations are proposed for flow, total suspended solids, toxic metals, and fluoride, and the estimated costs are given. The proposed NSPS are equivalent to the BPT limitations for the semi-wet segments and to the BAT limitations for the set segments, with the exception of the open hearth furnace subdivision; no more are expected to be built. The PSNS abd PSES standards are generally equivalent to the proposed BAT limitations and NSPS. For the vacuum degassing subcategory, BPT and BAT limitations are proposed for flow, total suspended solids, and toxic metals, and cost estimates are given. The proposed NSPS are equivalent to the proposed BAT effluent limitations. The standards for PSNS and PSES are based upon the filtration of a treatment and recycle system effluent. For the continuous casting subcategory, BPT and BAT limitations are proposed for flow, total suspended solids, oil and grease, and toxic metals, and the estimated costs are given.

BAT, NSPS, PSES, and PSNS limitations and standards are being proposed for zinc, chromium, and lead. The proposed NSPS are equal to the proposed BCT limitations for conventional pollutants. The proposed PSNS and PSES limits are identical to the BAT limits for toxic metals. (Brambley-SRC)
W82-03626

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY, VOL IV: HOT FORMING SUBCATEGORY.
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 5B.
W82-03627

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENTS LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY, VOL V: SCALE REMOVAL SUBCATEGORY, ACID PICKLING SUBCATEGORY.
Environmental Protection Agency, Washinton, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 5B.
W82-03628

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY, VOL VI: COLD FORMING SUBCATEGORY, HOT COATING SUBCATEGORY,
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
Environmental Protection Agency Report EPA-440/1-80/024-b, December, 1980. 606 p, 87 Fig, 177 Tab.

Descriptors: *Steel industry, *Wastewater treatment, *Industrial wastes, *Water pollution sources, Pollutants, Effluents, Flow control, Suspended solids, Oil, Grease, Heavy metals, Chlorinated hydrocarbons, Organic compounds, Costs, Water pollution control, Standards.

This volume contains the BPT, BCT and BAT effluent limitations, pretreatment standards for new and existing sources (PSNS and PSES), and new source performance standards (NSPS) for the cold rolling and cold worked pipe and tube subdivisions of the cold forming subcategory, and the alkaline cleaning and hot coating subcategories of the steel industry. In the cold rolling subdivision limits are proposed for flow, total suspended solids, oil and grease, total chromium, lead, total zinc, trichloroethane, nitrophenol, anthracene, tetrachloroethylene, and pH. The cold worked pipe and tube subdivision operations may use water or soluble oil solutions. For both operations zero discharges are proposed for all limitations and standards except PSES and PSNS for operations using water. BPT effluent loadings are proposed for flow, total suspended solids, oil and grease, dissolved iron, toxic metals and toxic organics in alkaline cleaning subcategory. In the hot coating subcategory effluent limitations are proposed for flow, total suspended solids, oil and grease, cadmium, total chromium lead, zinc and pH. For each category the estimated cost of implementing the control strategies are estimated. (Brambley-SRC)
W82-03629

PALM OIL WASTE TREATMENT STUDY IN MALAYSIA,
Asian Inst. of Tech., Bangkok (Thailand).
K. S. Hum, N. C. Thanh, and T. L. Lee.
Effluent and Water Treatment Journal, Vol 21, No 10, p 452-455, October, 1981. 1 Fig, 6 Tab, 4 Ref.

Descriptors: *Industrial wastes, *Wastewater treatment, Activated sludge, Digestion, Aerobic digestion, Anaerobic digestion, Anaerobic lagoons, Aerated lagoons, Lagoons, Food-processing wastes, *Palm oil wastewater, *Malaysia.

A palm oil wastewater treatment study was initiated in 1977 by the Asian Institute of Technology and the Division of Environment, Ministry of Science, Technology, and Environment, Malaysia. The combined wastewater from a palm oil mill is mainly composed of two kinds of wastes, the sterilizer condensate and the oil clarifier discharge. The waste is biologically degradable. Anaerobic ponds will generally be the simplest and cheapest anaerobic form of treatment for this wastewater. However, anaerobic ponds will not achieve an effluent quality suitable for discharge to a receiving water and a final aerobic stage of treatment be needed. At detention times between 15 and 20 days, 95% or more BOD5 and COD were removed by the anaerobic pond treatment. Various aerobic biological unit processes were then attempted for further treatment. Generally, aerobic processes were successful in removing 86-94% of BOD5 but only 60-68% of COD. Treatment methods employed included extended aeration with activated sludge process, aerated lagoons, biodrum, trickling filter, oxidation ditch and oxidation ponds. In cases where land prices are not high, anaerobic ponds followed by aerated lagoons would be an attractive combination for the treatment of palm oil wastewater in the tropical environment. However, high land costs could justify other treatment systems such as high rate digestion tank and/or activated sludge systems. (Baker-FRC)
W82-03632

WASTEWATER EFFECTS ON A WATERHYACINTH MARSH AND ADJACENT IMPOUNDMENT,
Universidad Nacional de Nicaragua, Managua.
A. Velga, and K. C. Ewel.
Environmental Management, Vol 5, No 6, p 537-541, November, 1981. 5 Fig, 2 Tab, 15 Ref.

Descriptors: *Wastewater disposal, *Water hyacinth, Water quality management, *Wastewater treatment, Phosphorus, Nutrients, Lakes, Ponds, Marshes, Florida, *Nutrient removal.

A study was conducted to determine the capability of a water hyacinth-dominated marsh to absorb nutrients from secondary sewage effluent, and thereby prevent eutrophication in an adjacent impoundment without additional management. Lake Alice, a shallow impoundment located on the campus of the University of Florida at Gainesville, was studied. The lake has received wastewater from the campus sewage treatment facilities since early 1960's. The lake has two components: a 21-ha shallow marsh to the east, dominated by waterhyacinths, and a deeper open water area to the west. The sewage treatment plant effluent and a stream that drains a small sinkhole are now the two major water inputs to the lake. The facility discharges about 7500 cubic meters/da. Retention time for the lake in the mid 1970's was about 4 days, but has doubled due to the diversion of effluent from a cooling system in 1976. Water flows from the marsh area into the area that is maintained free of waterhyacinths, and is discharged through wells at the far end of the impoundment. A water budget for the basin was estimated; phosphorus concentrations were monitored monthly at three stations in the marsh and at the discharge wells in the lake. Productivity levels were measured monthly where the marsh joined the lake and at the discharge wells. Only 16% of the phosphorus that enters the basin is stored. Gross primary productivity levels in the open water areas are very high, but high respiration rates appear to keep the lake in steady state. (Baker-FRC)
W82-03634

SOME METHODS AVAILABLE FOR TREATMENT OF WASTE WATER IN THE DAIRY INDUSTRY,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
M. A. Bull, R. M. Sterritt, and J. N. Lester.
Journal of Chemical Technology and Biotechnology, Vol 31, No 10, p 579-583, October, 1981. 33 Ref.

Descriptors: Wastewater, Effluent limitations, *Wastewater treatment, *Dairy industry, *Animal wastes, Recycling, Waste recovery, Filtration, Activated sludge, Ion exchange, Electrical equipment, Flocculation, Chemical coagulation, Farm wastes.

Methods of treating dairy waste water are reviewed. Typical ranges of effluent characteristics are presented, conventional methods of treatment are discussed and their disadvantages highlighted. Emphasis is placed on less common techniques of treatment including processed involving by-product recovery. Those processes concerned with protein recovery from whey have the greatest potential for future use within the industry and should be considered at the design stage of a new plant. Alternating double filtration is an effective treatment method which requires high land usage. Fixed film biological treatment methods are also possible, but their usefulness is limited by problems which frequently result in failure of the anaerobic processes. (Titus-FRC)
W82-03650

SLUDGE HANDLING AND DISPOSAL AT THE CENTRAL PROCESSING FACILITY, MONROE COUNTY, NEW YORK,
Monroe County Water Authority, Rochester, NY.
C. M. Frenz.
Journal of the New England Water Works Association, Vol 95, No 3, p 208-216, 1981.

Descriptors: *Sludge disposal, *Wastewater treatment, Water treatment facilities, Sludge drying, Dewatering, Sludge filters, Sludge thickening, *Monroe County, New York.

A joint venture study was conducted in 1971 to determine the most economically feasible plan to solve an existing pollution problem resulting from sludge contamination in Monroe County, New York, where sludge was entering the waters of Lake Ontario. At that time there were three water treatment plants. In this case the three water treatment plants were operated by distinct entities, one a municipality, one a private industry, and the third a public benefit corporation, the Authorit. The system as devised calls for equalized flow of wastewater of about one percent or less solids content being pumped to the processing facility, where each party's flow and solids are measured. Chemical inventory at each water treatment plant is a back-up to the solids meters. Wastewater enters two sludge thickener tanks. The thickened sludge is pumped to the reaction mixer and conditioned by the addition of lime, then further concentrated in the sludge decant tank, where the solids content reaches a maximum of about 9%. Supernatant from the thickener flows directly to the ship channel, where it is discharged without further treatment. Conditioned sludge from the decant tank is held in a retention tank, where polymer is added until sufficient inventory is available for a filter run. Filtrate removed is neutralized and discharged into the ship channel. The dewatered sludge cake drops into a storage bunker. While the facility is working well, further study is needed to test and improve operational procedures to produce the desired dewatered sludge at the optimum cost. (Baker-FRC)
W82-03664

PROCEDURES FOR ESTIMATING DRY WEATHER POLLUTANT DEPOSITION IN SEWER SYSTEMS,
Environmental Design and Planning, Inc., Boston, MA.
W. C. Pisano, C. Queiroz, G. L. Aronson, F. C. Blanc, and J. C. Shaughnessy.
Journal Water Pollution Control Federation, Vol 53, No 11, p 1627-1636, November, 1981. 3 Fig, 3 Tab, 7 Ref.

Descriptors: *Sewer systems, *Mathematical models, *Deposition, Sewers, Flushing, Solids, Sewage districts.

A predictive tool was developed, capable of defining on a preliminary basis the total amounts of solids and other pollutants that deposit in a sewer system. The model was a single-term power function relating total daily wastewater deposition over a collection system to simple sewer-shed characteristics such as service area, manhole-to-manhole length, etc. The physical characteristics of 75 collection subsystems from three major sewer systems in Massachusetts were analyzed. Data from field flushing experiments were used to estimate daily deposition loadings for some pollutants. The model was applied to a combined sewer collection system, and the estimated values given by three possible regression equations were reasonably close to the value derived from a detailed collection system model. (Small-FRC)
W82-03679

ANAEROBIC ACTIVATED CARBON FILTER FOR THE TREATMENT OF PHENOL-BEARING WASTE WATER,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
K. A. Khan, M. T. Suidan, and W. H. Cross.
Journal Water Pollution Control Federation, Vol 53, No 10, p 1519-1532, October, 1981. 14 Fig, 4 Tab, 25 Ref.

Descriptors: *Phenols, *Glucose, *Carbon filters, *Methane, *Anaerobic digestion, Organic carbon, Total organic carbon, Organic wastes, Activated carbon, Biodegradation, Anaerobic conditions, *Wastewater treatment, Biological wastewater treatment, Chemical oxygen demand, Filters.

Two granular activated carbon-packed anaerobic bioreactors were constructed to test the treatment of phenolic waste water. One reactor system was fed a 2,000 milligram/liter glucose bearing substrate, while the other was fed a synthetic substrate bearing 200, 400, or 1,000 milligrams/liter of phenol. The first reactor was later fed an additional 200 or 400 milligrams/liter of phenol to assess the preacclimation and co-degradation patterns of glucose and phenol. The glucose-fed reactor effectively reduced the organic content of the feed substrate in 9.30 hours while producing an 87% methane-rich gas at 2,071 milliliters/day at STP. When the 200-milligram/liter phenol-bearing substrate was fed to another set of anaerobic activated carbon-packed filter columns, little methane was produced during the initial 135 days of continuous operation. After day 240, steady state operating conditions were achieved. At this steady-state, the first anaerobic column was responsible for reductions in COD, TOC, and phenol of 91, 86, and 99.85% respectively, overall. Methane gas production increased when the feed phenol content was increased to 400 and 1,000 milligrams/liter. When the 2,000-milligram/liter glucose-fed anaerobic system was fed an additional organic carbon source of phenol, methane production immediately increased. The biodegradation of glucose and phenol could occur simultaneously with no apparent antagonistic effects. (Geiger-FRC)
W82-03680

THE SUCCESSFUL TREATMENT OF TANKER BALLAST WATER AT A MEDITERRANEAN SITE,
H. W. Marson.
Progress in Water Technology, Vol 12, No 1, p 67-78, 1980. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Oily water, *Ballast, *Oil tankers, *Wastewater treatment, Oil pollution, Bilge, Ships, Water pollution prevention, *Mediterranean Sea.

A plant for the treatment of discharged tanker ballast water built at Sidi Kerir, Egypt, and its principles of operation are described. The 12,000 cu m/hr plant was started up in 1978 and has achieved an average oil content value of below 2 mg/liter. Oil is removed by surface skimming in storage tanks, followed by unassisted gravity separation in P-V tilted plate separators. The last traces of oil are removed by air bubble flotation and skimming in the holding basin. Plant effluent is finally released into the sea. An API sampler is located about 4 m from the final discharge weir. A reduction of the oil content of the polluted ballast water to below 10 mg/liter satisfies all official specifications and is the best that can be expected from gravity separation without the additional expense and control problems of aeration with or without flocculants and polyelectrolytes. The conditions at Sidi Kerir are particularly suitable for the methods used, which explains the facility's excellent results. (Small-FRC)
W82-03703

OIL-WATER SEPARATION BY INDUCED AIR FLOTATION,
Tulsa Univ., OK.
J. J. Byeseda.
PhD Thesis, 1980. 222 p, 25 Fig, 23 Tab, 37 Ref, 10 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-09640.

Descriptors: *Wastewater treatment, *Separation techniques, *Oily water, *Flotation, Bubbles, Oil wastes, Oil-water separation, Air flotation.

Brine solutions containing kerosine stabilized with oil-soluble petroleum sulfonates were treated by induced-air flotation in a continuous-flow pilot unit. The effects of inlet oil concentration, vessel residence time, air flowrate, bubble diameter, oil drop diameter, temperature, NaCl concentration, and cationic polyelectrolyte concentration were investigated. Oil drop and air bubble diameters, liquid residence time, and concentration of cationic polyelectrolyte were the most significant variables affecting overall flotation performance. Only drops larger than 2 micro m showed significant removal, while smaller drops were generated by the air-inducing rotor. The cationic polyelectrolyte improved flotation performance by increasing the number of large oil drops. The removal rate for each oil drop size was first order with respect to oil drop concentration and an experimental procedure permitting determination of the first-order rate constants for removal due only to bubble-drop interactions was developed. The oil drop and air bubble diameters were the only variables which affected these rate constants. Increasing oil drop diameter and decreasing bubble diameter increased the rate constants. Comparison of experimental and theoretically predicted rate constants showed that the mechanism of oil droplet removal by bubbles from 0.2 to 0.7 mm is one of hydrodynamic attachment in the wake behind the rising bubbles. (Sinha-OEIS)
W82-03719

RETROSPECTIVE ANALYSIS OF WATER SUPPLY AND WASTEWATER POLICIES IN PITTSBURGH, 1800-1959,
Carnegie-Mellon Univ., Pittsburgh, PA. Coll. of Humanities and Social Sciences.
T. F. Yosie.
PhD Thesis, May, 1981. 460 p, 9 Tab, 54 Ref, Numerous Footnotes. University Microfilms International, Ann Arbor, MI; Order No GAX81-18450.

Descriptors: *History, *Wastewater management, *Water quality management, *Water supply, Water policy, Public policy, Capital, Public health, Legal aspects, Social values, Sanitation, Technology, Sewerage, Pittsburgh, Pennsylvania.

This study is a retrospective technology assessment of wastewater and water quality decisions made by the city of Pittsburgh in the period from 1800 to 1959. The study focuses upon the areas of technology development and implementation, impacts in the health, environmental, governmental, economic, and values areas, and the development of policies to deal with both implementation and regulation of water quality impacts. The major conclusions to emerge from the study are as follows: (1) sewerage technology transferred the locus of pollution from the immediate locale to downstream or adjacent cities and illustrates the difficulty in changing a capital-intensive technology implemented for beneficial reasons when the negative impacts of the technology are felt by second parties; (2) the existence of an in-place capital-intensive technology and the policy of dealing with its negative impacts by retrofit discouraged attempts to deal with the original problem by other means; and (3) general societal values were integral to the acceptance of the technology as well as the values of specific groups who wished to promote social change through its implementation; in addition, the positive and negative impacts of the technology had unexpected effects upon the values of society. (Sinha-OEIS)
W82-03721

PREDICTING SUSPENDED SOLIDS REMOVAL IN PILOT SCALE SEDIMENT PONDS UTILIZING CHEMICAL FLOCCULATION,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
J. S. Tapp, Jr.
PhD Thesis, 1981. 506 p, 150 Fig, 28 Tab, 148 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-18534.

Descriptors: *Suspended solids, *Flocculation, *Coagulation, *Runoff, Mining engineering, Model studies, Rainfall, Chemical coagulation, Forecasting, *Settleable solids, Sediment ponds.

The research described in this report was conducted to gain insight into the coagulation-flocculation process as it applies to runoff and eroded material from large precipitation events typical of those found in steep sloped watersheds. Laboratory and pilot scale tests were conducted to evaluate the effectiveness of induced coagulation/flocculation on total suspended solids removal in mine sediment ponds and to evaluate commonly used procedures for designing sediment ponds. The laboratory and pilot scale tests showed that chemical coagulation/flocculation produced suspended solids removal to a concentration of approximately one order of magnitude less than when no chemical was added. Based on the data collected during the laboratory and pilot scale phase of the research, various models for use in designing sediment ponds utilizing chemical flocculation agents were developed. Also, new routines were developed to make existing sediment pond models more descriptive of the settling and transport process occurring in a sediment pond. Although the soil and overburden used in the research were typical of that from surface mine sites, the models and procedures developed can also be used when treating sediment in runoff from other land uses such as urban, agriculture, silviculture and construction. (Sinha-OEIS)
W82-03725

CHARACTERISTICS OF AN AERATED LAGOON FOR MUNICIPAL WASTEWATER TREATMENT,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
M. Norouzian.
PhD Thesis, April, 1980. 246 p, 25 Fig, 68 Tab, 114 Ref, 5 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-26725.

Descriptors: *Wastewater treatment, *Aerated lagoons, *Algal growth, Algae, Suspended solids, Municipal wastewater, Nitrification, Nutrients, Water quality standards, Pilot plants.

The objective of this research was to conduct a pilot plant study of a multicell aerated lagoon system treating domestic wastewaters with emphasis on changes in nutrients which affect algal growth in receiving waters. Two 3 cell aerated lagoons were constructed and operated for one year. The aerated lagoon had a 24 hour completely mixed cell followed by a 4 day partially mixed cell and a 9 day cell for solids separation. Data indicated that the 14 day aerated lagoon could produce a high quality effluent as far as BOD sub 5 and suspended solids reductions of the initial wastewaters were concerned. Approximately 40% of the nitrification reaction occurred in the 24 hour cell during summer operations with nitrification being completed in the second cell. When the ammonia nitrogen concentration was increased, nitrification destroyed the bicarbonate alkalinity and lowered the pH to 5.5. The effluent from the aerated lagoon under these conditions did not support algal growth over a period of one month. The wood media surfaces improved effluent quality by

retaining microbial solids. For the most part effluent quality from an aerated lagoon treating municipal wastewaters is dependent upon the growth of algae and the removal of suspended solids. The three cell aerated lagoon is a simple treatment system which can be easily designed, constructed and operated to provide good wastewaters treatment for small communities and for developing nations with limited resources. (Sinha-OEIS)
W82-03727

EPA'S I/A PROGRAM SPEEDS USE OF NEW WASTEWATER TREATMENT METHODS,
G. Dallaire.
Civil Engineering (New York), Vol 51, No 11, p 62-64, November, 1981.

Descriptors: *Grants, *Technology, *Wastewater treatment, Financing, Disinfection, Ultraviolet radiation, Aquaculture, Algae, Fish, Alternative technology, Innovative technology, Land treatment, Municipal wastewater, Research priorities, Fluidized beds, Ponds, Nutrient removal, Water hyacinth, Sludge digestion, Composting, Economic aspects, Costs.

The federal construction grants program was modified in 1977 to pay for 85% instead of 75% of design and construction costs if a community used an innovative/alternative technology for wastewater treatment. Alternative methods have been proven (land treatment, anaerobic digestion, earth mounds, sludge incineration, etc.) Innovative technologies have not yet been proven (ultraviolet disinfection, fluidized bed processes, deep shaft aeration, etc.). The goal of the projects now in progress is to produce savings in costs and energy, better quality effluents, and more environmentally suitable treatment systems. Several programs are cited as illustrations. Nassau County, New York, is planning a 10 mgd fluidized bed wastewater treatment facility to expand its activated sludge treatment plant. Water hyacinth ponds remove solids and nutrients in Austin, Texas (activated sludge digester supernatant) and in Shreveport, Louisiana (140,000 gpd raw sewage). Smithsburg, Maryland, has decided on ultraviolet disinfection of wastewater rather than a dechlorination plant as a means of protecting trout in the receiving stream. A three-lagoon aquaculture system is being tried in New Castle, Virginia, in place of an expensive high rate trickling filter system packed with plastic media. Worms are digesting raw sludge, undigested and underwatered, into a solid compost at Lufkin, Texas. Many of these communities would not have attempted innovative technologies without financial aid and the assurance that funds were available for corrective action in case the experimental projects failed. (Cassar-FRC)
W82-03737

5E. Ultimate Disposal Of Wastes

FOUR OPTIONS FOR HAZARDOUS WASTE DISPOSAL,
Municipal Environment Research Lab., Cincinnati, OH.
R. D. Hill, N. B. Shomaker, R. E. Landreth, and C. C. Wiles.
Civil Engineering, (New York), Vol 51, No 9, p 82-85, September, 1981. 2 Fig, 2 Tab.

Descriptors: *Hazardous materials, *Waste storage, Storage requirements, Disposal wells, Wells, Injection wells, Underground waste disposal, Storage, Landfills, Waste dumps, Land disposal, Groundwater pollution, *Waste disposal.

Four options for hazardous waste disposal are considered: landfills with the option of fixation before landfilling, land treatment, mine storage, and deep well injection. A hazardous waste landfill is a facility that has received a permit from the US EPA or a state agency to dispose hazardous waste by the landfill method. The landfills must be carefully engineered to provide long-term protection of groundwater, surface water, air and human health. All surface water discharges must be in compliance with the National Pollutant Discharge Elimination System requirements. Rainfall patterns in the area need to be considered to determine runoff controls and diversions. Waste stabilization/solidification is a pretreatment process that has been proposed to insure safe disposal of wastes containing harmful constituents. Solidification improves the handling and physical characteristics of the waste. Use of land treatment can provide an efficient and cost effective treatment and disposal alternative when properly used. The technique is a dynamic process involving the interaction of waste, site, soil, climate, and biological activity, usually aerobic, to degrade, immobilize, or deactivate the waste constituents. Contaminants are reduced to acceptable limits, usually through biological degradation. Mine storage involves packing solidified wastes in drums, transporting them down mine shafts, and placing them in prepared rooms. The areas are segregated to contain wastes that are compatible with one another. The atmosphere is very dry, and the drums have an indefinite life unless corroded from the inside. Deep well disposal involves injection of liquid waste into subsurface geologic formations by means of wells.
W82-03416

HEAVY METALS IN SEWAGE SLUDGE--A MAJOR TOPIC OF JOINT EUROPEAN RESEARCH,
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-.Boden-, und Lufthygiene.
R. Leschber.
Water Science and Technology, Vol 13, No 4/5, p 1087-1088, 1981.

Descriptors: *Heavy metals, *Research priorities, *Sludge utilization, International commissions, Europe, Sludge disposal, Environmental effects.

The problem of heavy metals in sewage sludge has been the subject of research conducted by the Second Research Program on Sewage Sludge, COST 68bis, of the CEC, since 1978. Working Party 2 has been active studying analytical methods for sludge digestion samples and the determination of heavy metals in digested samples. These results were reported at a Vienna symposium in October 1980. Working Party 5 is using the United Kingdom as a pilot country for studying the effects of heavy metals on soil and plants. (Cassar-FRC)
W82-03435

U. N. LAUNCHES INTERNATIONAL WATER DECADE; U. S. ROLE UNCERTAIN,
For primary bibliographic entry see Field 5G.
W82-03449

ROCKY MOUNTAIN ARSENAL: LANDMARK CASE OF GROUNDWATER POLLUTED BY ORGANIC CHEMICALS, AND BEING CLEANED UP.
For primary bibliographic entry see Field 5B.
W82-03458

ENERGY CRISIS REDIRECTS SLUDGE DISPOSAL PERSPECTIVES: PART II,
N. W. Schmidtke.
Water and Pollution Control, Vol 118, No 5, p 26, 28-29, May, 1980.

Descriptors: *Sludge disposal, *Sludge utilization, Digested sludge, *Land disposal, Municipal wastewater, Metals, Land reclamation, Agriculture, Composting.

The perception of sewage sludge as a disposal problem must change to recognition of sludge as a resource if cost effective and environmentally acceptable sludge management strategies are to be developed. Sludge disposal options currently available include sanitary landfills, incineration, ocean disposal, and underground disposal. Each of these options poses particular problems, and only incineration offers the possibility of resource recovery through the incorporation of heat recovery or power generation facilities. Several sludge utilization options are currently being investigated, including direct constituent recovery, land reclamation, application to agricultural land, and sludge composting. Many municipal sludges contain high concentrations of metals, phosphorus, precipitants such as iron and lime, and even precious metals, including gold and silver. Metal recovery is contemplated in some areas. Sludge has been successfully used for land reclamation purposes in several areas. Digested sludge has been used to generate topsoil for parks and golf courses, to stabilize and reclaim acid mine tailing areas and dredged river sand deposits, and to restore land to agricultural productivity. Sludge has been applied to agricultural lands for centuries to restore nutrients and organic materials. Sludge composting and the sale of sludge as a soil amendment are also being practiced in some areas. (Carroll-FRC)
W82-03482

DESIGN MANUAL; ONSITE WASTEWATER TREATMENT AND DISPOSAL SYSTEMS,
Rural Systems Engineering, Madison, WI.
For primary bibliographic entry see Field 5D.
W82-03538

THE ADSORPTION CHARACTERISTICS OF SOILS AND REMOVAL OF CADMIUM AND NICKEL FROM WASTEWATERS,
College of Petroleum and Minerals, Dhahran (Saudi Arabia).
M. Sadiq, and T. H. Zaidi.
Water, Air, and Soil Pollution, Vol 16, No 3, p 293-299, October, 1981. 2 Fig, 4 Tab, 13 Ref.

Descriptors: *Heavy metals, *Adsorption, *Wastewater disposal, Sludge disposal, *Land application, Fate of pollutants, Cadmium, Nickel, Metals, Precipitation, Soil properties, Cation exchange.

Adsorption of cadmium and nickel from municipal wastewaters spiked to 100 ppm of each metal was tested by shaking soil-wastewater mixtures for 50 days. Precipitation, not adsorption, appeared to be the major mechanism of removal in all 27 experimental soils. In the Cd experiments the following soil characteristics were correlated with Cd sorption: after 1 day of shaking-surface area, total Fe, total Al, total Ca, free $CaCO_3$, saturated paste pH, and suspension pH. After 50 days only saturated paste pH and suspension pH were significantly correlated with Cd removal from wastewater. Clay content, organic matter, and cation exchange capacity were not correlated with Cd removal at any time during the experiment. In the Ni experiment the surface area, clay content, total Fe, total Al, total Ca, saturated paste pH, and suspension pH were correlated with Ni removal from wastewater after 1 day of shaking. At 50 days, surface area, total Fe and Al, and both pH parameters were still significant. Organic matter, cation exchange capacity, and free $CaCO_3$ were not significant in Ni adsorption at any time. Present guidelines for applying sewage sludge to soil rely on cation exchange capacity of the particular soil. This study suggests that precipitation, not adsorption or cation exchange capacity, should be the basis of any predictive model for estimating Cd and Ni removal in soils. (Cassar-FRC)
W82-03553

A CLOSER LOOK AT DEEP WELL DISPOSAL OF WASTES,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
R. G. Kazmann.
Ground Water, Vol 19, No 3, p 258-261, May/June, 1981.

Descriptors: *Waste disposal, *Aquifers, *Deep wells, *Saline water, *Geologic formations, Wells, Faults, Injection wells, Clays, Permeability, Oil wells.

The potential movement of wastes from deep injection wells to potable aquifers is examined in the Gulf Coast area. It was found that brine pressure in the deep well is approximately equal to sub-sea pressures, and that target aquifers are sandwiched between clay layers. The faults found in the Gulf Coast area serve primarily as obstacles to the flow of fluids. Abandoned test holes will not serve as conduits for the movement of wastes into overly-

ing formations of extremely low permeability. Deep well injection is considered the preferred method of toxic waste disposal under the conditions which exist in the Gulf Coast area, because it is unlikely that contamination would occur in the present era of geologic history. (Titus-FRC)
W82-03646

SLUDGE HANDLING AND DISPOSAL AT THE CENTRAL PROCESSING FACILITY, MONROE COUNTY, NEW YORK,
Monroe County Water Authority, Rochester, NY.
For primary bibliographic entry see Field 5D.
W82-03664

REGULATION OF UTILITY WASTE DISPOSAL PRACTICES,
K. D. Yard.
Power Engineering, Vol 85, No 11, p 83-85, November, 1981. 2 Fig, 2 Tab.

Descriptors: *Regulations, *Utilities, *Waste disposal, Industrial wastes, Hazardous materials, Groundwater, Water pollution sources, Water pollution control, Solid waste disposal, Wastewater disposal, Land disposal.

This article attempts to clarify the current regulatory picture as it relates to the utility industry and provide insight into possible future regulations. The legislative stimulus for new solid waste regulatory programs originated with the Resource Conservation and Recovery Act (RCRA) of 1976, which completely replaced the provisions of the Solid Waste Disposal Act of 1965 and expanded the role of the Environmental Protection Agency in solid waste management. The Act was designed to promote resource conservation and safe disposal of waste materials, and to direct the EPA to promulgate regulations to protect human health and the environment from the improper disposal and management of hazardous wastes. EPA regulations require the identification of waste materials as hazardous if they are included in a comprehensive list of waste sources and waste streams, or if they exhibit hazardous characteristics, such as toxicity, corrosivity, reactivity and ignitability. The criterion requiring groundwater protection has the greatest potential impact on utility waste disposal practices. It stipulated that a solid waste disposal facility must not contaminate an underground drinking water source beyond the solid waste boundary or an alternative boundary established by the state. The surface water management criterion refers to the Clean Water Act for control of point source discharges. Achieving regulatory compliance at already existing sites may not be straightforward. Strict compliance at some sites may not be possible. Coal burning wastes for the present are classified as non-hazardous while a study is being conducted. (Baker-FRC)
W82-03691

5F. Water Treatment and Quality Alteration

TRIHALOMETHANES IN DRINKING WATER,
Montgomery (James M.), Inc., Pasadena, CA.
M. D. Umphres, A. R. Trussell, C. H. Tate, and H. R. Trussell.
Water/Engineering and Management, Vol REF, No HB p R65-R66, R68-R70, R72-R74, R76, 1981. 8 Fig, 4 Tab, 43 Ref.

Descriptors: *Water quality, *Disinfection, *Trihalomethanes, Humus, Chlorination, Chlorine, Wastewater treatment, Activated carbon, Adsorption, Adsorbents, Ozonation, Potable water, Water treatment facilities, Methane, Organic compounds.

The presence of trihalomethanes (THM) in drinking water has caused concern over the past several years. In 1974 significant levels of THM were identified at the Rotterdam water utility in water which had just been chlorinated as part of the disinfection process. THMs are the products of the reaction of chlorine with humus. Due to the complexity of the organic precursors and the variety of possible reaction pathways, the chemistry of the THM reaction is not completely understood. Several analytical methods are available for measuring THMs in the low microgram/liter range. Many treatment alternatives have been considered for controlling THMs. Those with the greatest application involve minor adjustments in operation of existing unit processes such as reducing the chlorine dosage or changing the point of chlorination. These modifications include removing the THM precursor prior to chlorination, using an alternative disinfectant which does not form THMs, or removing the THMs after they are formed. Removal of the precursor can be achieved with granular activated carbon or ozonation. Alternative disinfectants include chlorine dioxide, ozone, chloramines, or combinations of disinfectants. Removal of THM can occur through adsorption techniques, packed-tower aeration, or the use of activated carbon. Treatment costs must be considered in any investigation of alternative methods and process changes. However, it is essential that all aspects of water quality and treatability be carefully examined and evaluated before a cost comparison is undertaken for a given treatment facility. (Baker-FRC)
W82-03447

OZONE WATER TREATMENT SYSTEMS,
PCI Ozone Corp., West Caldwell, NJ.
C. Nebel.
Water/Engineering and Management, Vol REF, No HB, p R77-R80, 1981. 8 Fig, 1 Tab.

Descriptors: *Ozonation, Solubility, Dissolved solids, *Water treatment, *Potable water, Disinfection.

When ozone is used to treat potable water, it must be transferred from the air in which it was generated to the liquid phase. This is called mass transfer. Several variables affect mass transfer, including dissolved organic materials which react chemically with ozone. The amount required in a treatment plant is largely dependent on the amount of dissolved organic materials in the water. Water temperature plays an important role. Decreasing water temperature increases the solubility of ozone. Mixing increases the rate of ozone mass transfer by thinning the liquid interfacial film. Mixing also increases the rate at which residual ozone is destroyed, which in turn decreases the rate of microorganism inactivation. Bubble size affects ozone transfer, which is increased by having the maximum area available between the water and the ozonated air. Slowing the ascent speed of bubbles will also increase transfer efficiency, water depth in an ozone contactor can serve as a means to increase the contact time between the bubbles and the water. Contact time is significant to disinfection. The speed of disinfection by ozone has been observed to be significantly faster than disinfection by chlorine. Higher pH values catalytically destroyed ozone residuals in water by interaction with the hydroxyl ion. Since most ozone contacting systems do not transfer all the ozone from its carrier gas to the water, the off-gases from the contactor contain small amounts of ozone. There are many methods of off-gas treatment including dilution, decomposition of ozone by granular activated carbon, catalytic destruction, thermal destruction, and off-gas reinjection. (Baker-FRC)
W82-03448

CARBON TREATMENT OF DRINKING WATER: N.J. PLANT TRYING TO GET OUT THE BUGS,
G. Dallaire.
Civil Engineering (New York), Vol 50, No 1, p 64-67, January, 1980. 3 Fig.

Descriptors: *Activated carbon, *Organic compounds, *Regeneration, Water treatment, Trace levels, *Passaic, *New Jersey, Filtration, Adsorption, Pilot plants.

The Passaic Valley, New Jersey, water treatment plant has been experimenting with activated carbon for removing the numerous synthetic organic chemicals in its raw water source. Trace synthetic organics removal is not to be equated with removal of odor, taste, and turbidity by activated carbon filters, an effective process in common use. Water filters through a 33 inch deep bed of granular activated carbon in 8 ft x 28 ft tanks. After two years of work, the percentage of organics removed and the best type of activated carbon has not yet been determined. Problems and unknowns include the desorption of chemicals into the effluent, frequency of regeneration, strict standards on regeneration, corrosion of equipment, and moving the carbon to the regeneration furnace. In experiments at the Jefferson Parish Water Department, New Orleans, it was established that a 20 min contact time is necessary for organics removal. Large molecules such as pesticides are moved more effectively than small molecules such as trihalomethanes. Problems with activated carbon treatment can be engineered out by constructing 2 to 4 full-scale demonstration carbon treatment plants so that each water works will not have to 'reinvent the wheel.' However, some communities have immediate problems with organics and cannot wait for information from demonstration projects, which is at least five years away. (Cassar-FRC)
W82-03461

MIXED BED TECHNOLOGY FOR POLISHING MAKE-UP WATER AND CONDENSATE RETURN, PART ONE,
R. A. F. Scott.
Effluent and Water Treatment Journal, Vol 21, No 3, p 113-115, 117-120, March, 1981. 4 Fig, 3 Tab, 20 Ref.

Descriptors: *Iron exchange, *Resins, *Boiler water, *Condensates, *Water treatment, Water purification, Regeneration, Fouling, Filtration, Anion exchange, Cation exchange.

This paper presents the current state of technology of the mixed bed process for polishing condensate return or water substantially deionized by preceding processes. The regeneration sequence for the mixed anion-cation resin involves backwash, settling, caustic regeneration and rinse, acid regeneration and rinse, air mixing, and final rinse. Technologies available to ease organic fouling problems are the total organic carbon analyzer for monitoring low levels of organic matter and improved acrylic base resins. Silica leakage may be minimized by removing silica by a working anion unit prior to the mixed bed polisher, by the countercurrent technique, or using the Hipol process. Recommendations for the minimum regeneration level are 64 g NaOH per liter anionic resin and 48 g H_2SO_4 per liter of cation resin. Service flow rates as high as 50 meters per hour are conventional. Specifications for polished condensate are given, with 1 ppb maximum levels for NaCl and Fe in the U.S. Sources of contamination in the condensate are boiler feed makeup water, chemical additives, corrosion and erosion products, air ingress, condenser leakage, and reserve feed water. Although the first mixed bed polishing units had filtration units installed ahead of the ion exchange section, more recent technology uses the polisher itself as a highly efficient filter. Other methods of improving filtrate efficiency are precation units to protect against iron and powdered resins for precoat filtration. Using the mixed bed unit as a filter can cause physical and/or chemical fouling. Techniques for solving these problems are backwashing, air sparging, air bump-rinse out, external resins regeneration, ultrasonic resin cleaning, sub-surface washes, and split bed polishers. (Cassar-FRC)
W82-03471

OUTLOOK FOR WATER AND WASTEWATER SYSTEMS, PROCESSES, AND EQUIPMENT: COMMENTS FROM METCALF AND EDDY, INC., BOSTON, MA,
J. E. Moore.
Water/Engineering and Management, Vol 128, No 3, p 90, March, 1981.

Descriptors: *Wastewater treatment, *Water treatment, *Equipment, Drinking water, Projections, Sludge utilization, Energy conservation, Energy production, *Water treatment facilities.

Metcalf and Eddy, Inc., presents its predictions with respect to water and wastewater treatment

developments. The water treatment industry may expect an increase in the need for waterworks treatment equipment and systems as a result of implementation of the Safe Drinking Water Act. This is particularly true in areas where systems will be required to switch from simple chlorination to full treatment for the removal of turbidity. The wastewater treatment industry can expect continuation of the present major interest in energy saving equipment. Increased interest in the reuse of wastewater for agricultural purposes or aquifer recharge and in sludge recycling for agricultural use or as an energy source can also be anticipated. Manufacturer equipment sales are decreasing. In addition, the quality of equipment has generally decreased with increased competition, as has the willingness of manufacturers and suppliers to provide maintenance assistance and general service. (Carroll-FRC)
W82-03473

CHLORINATION OF DRINKING WATER AND PREGNANCY OUTCOMES IN NEW YORK VILLAGES, 1968-1977,
Columbia Univ., New York.
For primary bibliographic entry see Field 5C.
W82-03506

A NOVEL CHLORAMINE COMPOUND FOR WATER DISINFECTION,
Auburn Univ., AL. Dept. of Chemistry.
H. D. Burkett, J. H. Faison, H. H. Kohl, W. B. Wheatley, and S. D. Worley.
Water Resources Bulletin, Vol 17, No 5, p 874-879, October, 1981. 4 Tab, 33 Ref.

Descriptors: *Disinfection, *Chloramines, Chlorination, *Water treatment, Toxicity, Solubility, Bactericides, 3-chloro-4,4-dimethyl-2-oxazolidinone, Water purification.

3-chloro-4,4-dimethyl-2-oxazolidinone (Agent I) was an effective disinfectant in a laboratory scale water treatment plant. Bacterial counts in raw water treated with Agent I were reduced from about 10 million per cc to about 1,000 per cc using a nutrient-agar (total colony count) detection technique. In all, 10 runs were made, using aluminum sulfate, lime, sodium silica fluroide (SIC), and Agent I alone and in combination. Best results were obtained (500-600 bacteria per cc) with lime, aluminum sulfate, Agent I, with or without added solution for at least 6 weeks in darkness or light and to 1 hour exposures of ultraviolet light. Solubility in water is 0.8 g per 100 cc at 2 c and 1.2 g per 100 cc at 28C. It has an apparent anticorrosive effect on metals. No toxicity was observed in 4 laboratory rats fed 10 to 200 ppm Agent I for 6 months. The slow release of chlorine provides prolonged bactericidal action. It is less likely to produce chlorinated hydrocarbons in the treated water. This compound shows potential for treating small water supplies such as wells and military field units. (Cassar-FRC)
W82-03551

REPLACING LARGE WATER METERS: WHY AND HOW,
Rockwell International, Atlanta, GA.
F. L. Russell.
Water/Engineering and Management, Vol 128, No 10, p 66, 68, 73, 1981. 3 Fig.

Descriptors: *Water metering, *Maintenance, Cost analysis, *Economic aspects, Water supply systems, Water meters, Water delivery, Pipelines.

During a recent in-the-field large meter test program, a significant number of units were found to be losing tens of thousands of dollars of revenue each year due to inaccuracy and obsolescence. These amounts of losses were far in excess of the cost of replacement of the malfunctioning units. In cases where there is a pressing need to maintain service during repairs, a temporary or permanent bypass must be installed around the meter if none exists. A temporary bypass made with service saddles, tapping valves and either fire hose or hard pipe can be used if the volume of water that can be supplied will be adequate. The primary problems to be anticipated in replacing a large water meter that has been in service for a lengthy period include difficulty in removing the old meter, as it has become bound into the pipeline as a result of lateral pressure; the possibility that the line will expand laterally into the gap when the old meter is removed and make it difficult to install a new meter of the same laying length; and a need for spool pieces and/or reducers to make up differences in size between the old meter and the new one. After the new meter has been installed with all connections secure, the valves must be slowly and partially opened in reverse order of the shutdown to allow the lines to fill slowly and reestablish pressure. (Baker-FRC)
W82-03560

DOWN TO EARTH LEAK DETECTION,
Water Treatment Plant, Traverse City, MI.
R. Bowen.
Water/Engineering and Management, Vol 128, No 10, p 62, 65, 1981.

Descriptors: *Leakage, Water conservation, Water loss, *Water supply systems, Valves, Hydrants, Measuring instruments, Maintenance, *Traverse City, *Michigan, Case studies, Pipelines.

In Traverse City, Michigan, a project was undertaken to determine where leaks in the water supply system were located and what was going on under the streets of the city. Practical experience indicates that any loss above 10% is worth some effort to control and that if losses are 20% or more a loss control program which includes leak detection is certainly called for. In Traverse City the loss was 35-40%, with increasing electrical costs. Assumptions were made that losses were due to official hydrant use, unknown unmetered use of water, and underground water leakage. A log was started to record the official use of hydrant water. Unmetered usage is hard to control. Underground leakage was investigated by use of an instrument designed for this purpose. After an examination during a quiet time for water usage, about 15% of the hydrants in the city were identified as noisy, indicating water leakage. Areas with two noisy hydrants in succession were examined first, as they indicated possible larger areas of concern. A check of the storm sewers was then made. If a flow was found it was sampled for chlorine and fluoride, the two chemicals added to city water and not found in groundwater. Suspected leaks were then pinpointed. Various factors which affect leak detection should be considered during operator training. Leak noise can vary according to conditions associated with the leak. Some general guidelines are offered. (Baker-FRC)
W82-03561

URBAN WATER SYSTEMS: PROBLEMS AND ALTERNATIVE APPROACHES TO SOLUTIONS,
Army Corps of Engineers, Belvoir, VA.
K. E. Schilling.
Journal of the New England Water Works Association, Vol 95, No 3, p 178-186, September, 1981.

Descriptors: Water supply, *Government supports, Urban areas, Water resources development, Financial aspects, Planning, Decision making, Administrative decisions, Federal jurisdiction, Political aspects, *Municipal water, *Water supply systems, Costs.

The Subcommittee on Urban Water Supply of the President's Intergovernmental Water Policy Task Force has commissioned an inventory of existing Federal programs with potential for assisting urban water system rehabilitation or construction; identified and evaluated institutional and money problems connected with supply and distribution of municipal water; and identified and assessed policy and program changes at the Federal, state and local level. Urban water system capital expenditures needed over the next 20 years are estimated to total $75-$110 billion. As many as two out of every ten urban water systems might experience capital investment shortfalls over the next 20 years. The shortfall thus created could range between $5-$26 billion. About one half of the total estimated national shortfall is attributed to distribution system needs and one-third to new source development needs. Municipally owned and operated water systems are four times as likely to experience shortfalls as privately owned systems. Federal categorical programs which supply assistance specifically for water supply purposes have limited applicability to urban water supply problems. Some Federal assistance programs do provide substantial sources of funding assistance which could be directed to water supply. The subcommittee suggests that the selection and implementation of any one or combination of policy approaches should occur in conjunction with a more detailed study of urban water resource problems to reduce uncertainties as implementation proceeds. (Baker-FRC)
W82-03580

KINETICS OF TRIHALOMETHANE FORMATION IN LYOPHILIZED POTOMAC WATER,
Howard Univ., Washington, DC. Dept. of Chemical Engineering.
M. M. Varma, R. C. Chawla, A. Balram, and H. M. Katz.
AIChe Symposium Series, Vol 77, No 209, p 220-226, 1981. 9 Fig, 6 Ref.

Descriptors: *Chlorination, *Trihalomethanes, *Kinetics, *Water treatment, Model studies, *Potomac River, Chlorinated hydrocarbons, Chloroform, Organic compounds, Fate of pollutants.

The solid residue from 20 gallons of lyophilized Potomac River water was resuspended in water and chlorinated to study trihalomethane formation. At a Cl dose of 2 mg per liter and solids concentration of 115 mg per liter, about 18 micrograms per liter trihalomethanes (mostly chloroform) formed within 6 hours. The trihalomethane concentration increased with increasing Cl dose, but not linearly. Chloroform formation also increased with increasing solids concentrations from 15 to 150 mg per liter. At the higher solids concentrations chloroform formation also increased with time up to 100 hours. A simple semiempirical model is given to use for this water. It should be applied with caution to other water sources or for the same water under drastically different conditions. (Cassar-FRC)
W82-03596

INTRAPARTICLE DIFFUSIVITY OF METHYLENE BLUE INTO POROUS ACTIVATED CARBON,
Tokushima Univ. (Japan). Faculty of Pharmaceutical Sciences.
K. Boke, S. Tanada, T. Matsui, T. Kuwahara, and A. Kotani.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 610-615, November, 1981. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Activated carbon, *Adsorption, *Diffusivity, Water treatment, *Methylene blue, Pore size, *Water pollution treatment.

The variation of the intraparticle diffusivities with the adsorption ratio up to 0.2 and the relationship between intraparticle diffusivity and pore size distribution of activated carbon were investigated. This information is essential for transferring from a batch adsorption system to a column adsorption system in water pollution treatment. Methylene blue was the adsorbate. A figure shows Freundlich plots (constants 19.12 to 176.60) of the adsorption isotherms of methylene blue on five activated carbons ranging in particle diameter from 4.08 to 4.65 mm and surface area from 378.0 to 1384.5 sq meters per g. The results of another figure imply that intraparticle diffusivities change with adsorption ratio. Methylene blue was mainly adsorbed in the micropores of activated carbon (pore diffusivity predominating over surface diffusivity) in the early stages of adsorption. The relationship between the intraparticle diffusivity and pore size distribution is illustrated by curves. (Cassar-FRC)
W82-03601

OPTIMIZING COAGULATION WITH PILOT FILTERS AND ZETA POTENTIAL,

American Water Works Service Co., Inc., Haddonfield, NJ.
W. E. Neuman.
Journal of the American Water Works Association, Vol 73, No 9, p 472-475, September, 1981.

Descriptors: *Coagulation, *Zeta potential, *Pilot plants, *Control systems, Filters, Chemical coagulation, Alum, Jar tests, *Water treatment, Turbidity, Monitoring, Quality control.

Zeta potential and pilot filters are practical testing techniques for coagulation control in water treatment plants. Zeta potential measures the strength of the negative change on the colloidal particles (turbidity) in raw water by adding a cationic coagulant to determine if cationic additions result in adequate neutralization of the negative charge. The velocity of migrating particles is measured by applying a direct current voltage across a sample cell. Examples of successful applications of zeta potential are given: latex spills into a river water supply, high turbidity values at winter temperatures, sludge blanket breakthroughs, and a daily afternoon peak in alum dosage. In all four cases zeta potential indicated much lower coagulant dosages than did other methods. In-line pilot filters provide instant alerts of change and keep a record of performance. Use of either of these two monitoring methods leads to more accurate chemical dosages, better understanding of filter processes, and a more uniform water quality. (Cassar-FRC)
W82-03653

UPGRADING TO INCREASE TREATMENT CAPACITY,
Environmental Science and Engineering, Inc., Gainesville, FL.
T. P. Brodeur.
Journal of the American Water Works Association, Vol 73, No 9, p 464-471, September, 1981. 15 Fig, 2 Tab.

Descriptors: *Flocculation, *Filtration, *Water treatment facilities, Upgrading, *Cost-benefit analysis, Manatee County, *Florida, Coagulation, Alum, Color removal, Sludge lagoons, Sludge thickening, Pilot plants, Costs, Water supply.

The Manatee County, Florida, water treatment plant was upgraded, enabling a 46% expansion to 54 mgd at capital cost savings of $2 million and energy savings of $10,000 per year. New filters were added. Two mechanical rapid mixers and twelve 40 hp mixers were eliminated. Flocculator units were divided into 8 compartments each. Perforated baffles were added to the settling basins for better distribution of flocculated water. Alum dosage was reduced from 70 to 50 mg per liter. Raw water colors were high, 151-200 pcu. Finished water colors before plant modification were 18-23 pcu, and after modification, 10 pcu or less. The effectiveness of the sludge lagoons was increased by allowing sludge to thicken to 2-3% in settling basins prior to discharge into the lagoons. (Cassar-FRC)
W82-03654

UPGRADING WATER TREATMENT PLANTS IN SAN DIEGO,
San Diego Water Utilities Dept., CA.
R. W. King, and E. I. Crossley.
Journal of the American Water Works Association, Vol 73, No 9, p 476-477, September, 1981. 1 Fig.

Descriptors: *Water treatment facilities, *Flocculation, Filter media, Filtration, Upgrading, Mixing, *San Diego, California, Water supply.

The City of San Diego, California, modified two of its three water treatment plants to increase capacity by 30% without changing the physical size of the plants or the water quality. The filter media was changed from sand to anthracite-sand, filter controllers were modified, and high energy mixers replaced rapid mixers and some flocculators. These modifications also handled a concurrent change in raw water quality. Previous supplies from the Colorado River needed only chlorination. The new supply was half Colorado River water and half from northern California, which required full treatment. (Cassar-FRC)
W82-03655

DECLINING-RATE FILTRATION,
Iowa State Univ., Ames. Dept. of Civil Engineering.
J. L. Cleasby.
Journal of the American Water Works Association, Vol 73, No 9, p 484-489, September, 1981. 7 Fig, 2 Tab, 13 Ref.

Descriptors: *Filtration, *Water level fluctuations, *Head loss, *Water treatment, Declining rate filtration, Turbidity, Pilot plants, Design criteria.

The use of declining-rate filtration is increasing in new water treatment plants. In this operation the filtration rate is allowed to decline from a maximum value in the beginning of the run when the filter media is clean to a minimum value when backwashing is done. Two pilot plant runs, one declining-rate filtration (DRF) and the other constant rate filtration (CRF), were operated at 3.39 mm per sec. The DRF produced better water, showed no terminal turbidity breakthrough, and had about 1/3 longer filter run than the CRF method. Differences in water quality were greater when the CRF was allowed to run to a breakthrough of 1 turbidity unit than when the two plants were operated by the same terminal head loss in the media. To convert an existing constant-rate or constant-head plant to declining-rate filtration the total head loss and variations in water level must be determined, preferably by pilot tests. Alternatives for plant conversion are: (1) installing a vented loop in the effluent pipe to limit the total head loss across the filter and fix the maximum water level at the desired position, (2) installing a vented overflow weir box in the effluent pipe, (3) installing a weir or an upturned pipe in the clear well, (4) installing an orifice or fixed position valve in the effluent pipe, and (5) converting the effluent valve to a two-position valve. Methods are given for estimating the changes in water level during backwashing operations in a multiple filter unit. The rise in water level decreases with increasing number of filters and increases with longer backwashing periods. (Cassar-FRC)
W82-03656

REMOVING COLOR AND CHLOROFORM PRECURSORS FROM LOW TURBIDITY WATERS BY DIRECT FILTRATION,
Stearns and Wheler, Cazenovia, NY.
L. E. Scheuch, and J. K. Edzwald.
Journal of the American Water Works Association, Vol 73, No 9, p 497-502, September, 1981. 13 Fig, 4 Tab, 27 Ref.

Descriptors: *Filtration, *Color removal, *Organic matter, *Water treatment, Direct filtration, Humic acids, Chlorinated hydrocarbons, Chloroform, Flocculation, Polyelectrolytes, *Raquette River, *New York.

Direct filtration of colored raw waters was evaluated using bench-scale pilot tests. Synthetic waters with colors of 55 pcu (5 mg per liter humic acid) and 110 pcu (10 mg per liter humic acid) and Raquette River, New York, water of 40 to 70 pcu color and low turbidity were treated with a cationic polyelectrolyte. Dosages of polymer were determined by jar test and varied from 3.5 to 8 mg per liter. Color reductions were as follows: 55 pcy water, 90%; 110 pcu water, 95%; Raquette River water, 75-85%. Chloroform precursors were reduced 50-60% for the synthetic waters and 40% for the river water. (Cassar-FRC)
W82-03657

COMPARATIVE PERFORMANCE OF DUAL- AND MIXED-MEDIA FILTERS,
Minneapolis Water Works, MN.
N. Qureshi.
Journal of the American Water Works Association, Vol 73, No 9, p 490-496, September, 1981. 7 Fig, 4 Tab, 10 Ref.

Descriptors: *Filters, *Performance evaluation, *Water treatment, Mixed media filters, Dual media filters, Sand filters, Filtration, Filter media, Comparison studies, Costs.

There was very little difference in performance between dual media (coal and sand) and mixed media (anthracite, sand, and high density sand) filters in pilot and plant scale tests conducted in the Minneapolis Water Works. In the initial stages of filter operation, the mixed media produced a slightly less turbid water than the dual media. A break-even point was reached at 24 hours, after which the dual media increased gradually in performance. The dual media had slightly lower head loss and equal or larger filter runs than the mixed media. Results of these findings and of previous work at other locations do not substantiate the belief that mixed media is superior to dual media, which costs $3.25 less to install than mixed media. These results should not be applied to other situations without considering variations in water quality and equipment. (Cassar-FRC)
W82-03659

METHODS FOR EVALUATING PERFORMANCE OF FILTER MEDIA,
Metcalf and Eddy, Inc., Boston, MA.
S. L. Bishop.
Journal of the New England Water Works Association, Vol 95, No 3, p 193-207, 1981. 10 Fig, 3 Tab, 4 Ref.

Descriptors: *Filter media, *Evaluation, *Water treatment, Water treatment facilities, Reverse osmosis, Turbidity, Head loss, Microscopic analysis.

Techniques used in evaluating the performance of filter media are discussed. These techniques involve evaluating either the quality or quantity of filtered water to determine optimal operating conditions. Quality considerations include turbidity, conditions. Quality considerations include turbidity, microscopic count, suspended solids, or the silt density index, while quantity considerations include the net unit production of water. The evaluation of the internal distribution of head loss is of interest in adjusting filter design during piloting of water processes. Measuring turbidity as an evaluation of the performance of granular media filters has limitations, as it is not an accurate indicator of the amount of suspended material in the water. Filtered water also contains quantities of amorphous material and plankton which are not detected in turbidity measurements. For these reasons microscopic analysis of filtered water has been used in many cases as a supplement to the standard use of turbidity in determining the performance of water treatment processes. Microscopic analysis has an inherent statistical problem involving the theory of random sampling and a human problem involving procedural errors or variations in the laboratory. These problems must be considered in each case. Studies have indicated that the multi-media filter is more efficient than the dual media filter in removing microscopic material and turbidity, even at twice the normal filtration rate. No relation could be found between the microscopic cound and the duration of filter run to a set terminal head loss. Suspended solids are not useful as an indicator of filter media performance because of procedural limitations involved in measuring their low values in filtered water. (Baker-FRC)
W82-03661

VINYL LINED ASBESTOS CEMENT PIPE PROBLEMS-HEALTH ASPECTS,
Dept. Environmental Quality Engineering, MA.
P. T. Anderson.
Journal of the New England Water Works Association, Vol 95, No 3, p 217-219, 1981.

Descriptors: *Pipes, *Water pollution sources, Chemical compounds, *Asbestos, Cement, Vinyl, Linings, Coatings, Organic compounds, *Water treatment, Drinking water.

The finding of tetrachloroethylene (TCE) in drinking water from public water supplies using vinyl lined asbestos-cement pipe was first noted in Massachusetts in late January of 1980. Additional investigation suggested a problem in the low flow

situations in vinyl lined AC mains with TCE levels significantly over the 40 ppb recommended safety level. In the state of Massachusetts there were about 94 public water supplies involved, with about 644 miles of vinyl lined AC pipe. Various steps have been tried thus far to solve the problem. Faucet aeration proved ineffective. Dilution was effective but impractical. Impractical also was steam cleaning and sand blasting. Addition of a cement lining resulted in a 97-99% reduction but the long term effect is not known and the cost is $10-$15 per foot. Flushing was effective, but also wasteful and difficult to monitor. Bleeding was generally effective. Carbon filtration was effective under 800 ppb but cartridge life was a problem. Five minutes of vigorous boiling at 2 inches deep removes 99%, but many concentrate other chemicals. Adjustment of pH, polyphosphate addition and super chlorination were not effective. Pipe replacement was effective but very expensive. (Baker-FRC)
W82-03663

CENTRAL CITY DEMANDS IN THE 80'S WOONSOCKET, RHODE ISLAND,
H. V. Patterson.
Journal of the New England Water Works Association, Vol 95, No 3, p 224-228, 1981.

Descriptors: *Water conveyance, *Financial aspects, *Water supply, Water rates, Economic aspects, Planning, Water management, Water distribution, Water delivery, Pipelines, Water mains, Conveyance structures, Water demand, *Woonsocket, *Rhode Island.

The existing water supply system in Woonsocket, Rhode Island is reviewed, and needs for the future are described. Before 1885 a reservoir (number 1) was constructed with an available water capacity of 30 MG, a pumping station was built, and the first water mains installed. The water company as such became municipally owned in 1885 at a cost of $280,000. It has never become self-sustaining. The Crook Fall Brook has remained the major source of supply, and is of very high quality. A second reservoir was built, but washed out in the early 1890's; a third one was built later. Chlorination was the only chemical treatment employed prior to building the new plant in 1962. Woonsocket's Central Area comprises 3 square miles. Sixteen of the 44 miles of pipe laid before 1900 are nominal 4 and 6 inches in size, unlined cast iron, which should be replaced. A bond issue was floated seven years ago to repaint and refurbish the water tanks and begin other repairs. However, the first tank examined was in such bad shape that most of the money went for it. Efforts are also underway for fire hydrant renewal. The greatest handicap in all the problems is the dependency on the general fund of the city. (Baker-FRC)
W82-03665

UNCERTAINTIES IN WATER DISTRIBUTION SYSTEMS,
For primary bibliographic entry see Field 8A.
W82-03668

HYGIENIC EVALUATION OF THE POLYAMIDE MEMBRANE PHEYLONE-2S AND PHENOL FORMALDEHYDE RESIN VIAM-B FOR USE IN REVERSE OSMOSIS TREATMENT OF WATER. (GIGIENICHESKAYA OTSENKA POLIAMIDNYKH MEMBRAN FENILON-2S I FENOLFORMAL'DEGIDNOI SMOLY VIAM B, PRIMENENYAEMYKH PRI OBRATNOOSMOTICHESKOM OPRECHNENII VODY),
Institute of General and Municipal Hygiene, Moscow (USSR).
For primary bibliographic entry see Field 3A.
W82-03698

BAYANIHAN, THE SPIRIT BEHIND THE PHILIPPINE WATER SUPPLY DEPARTMENT SCENE,
Aqua, No 6, p 7-9, 1981.

Descriptors: *Water resources development, *Water supply, *Water demand, Resources development, *Philippines, Urban areas, Rural areas, Drinking water, Potable water, Water management, Metropolitan water management.

The spirit of self-help lies behind the attempts being made in the Philippines to promote the drinking water supply development program. At the start of the 1970's a study indicated that the water works systems which were installed by the National Waterworks and Sewerage Authority (NAWASA) were not maintained properly and were breaking down at a much faster rate than rehabilitation and repairs could manage. Through a presidential mandate in 1973 the control of Philippine water supplies was placed under three separate agencies. The Metro Manila area and some six adjacent municipalities of the provinces of Cavite and Rizal fall under the responsibility of the Metropolitan Waterworks and Sewerage Systems (MWSS), with the rest of the country divided between the Local Water Utilities Administration and the Rural Waterworks Development Corporation. The RWDC undertakes development of water supplies in areas with less than 20,000 population. The LWUA handles water needs of cities and municipalities outside Metro Manila with more than 20,000 population. The water district is owned, operated, managed and controlled by the people themselves once it is operational and has settled obligations with the LWUA. Thus its development depends on the people in the locality it serves. Because of the popularity of the self reliance concept in the Philippines, this concept of water supply development is making great strides. (Baker-FRC)
W82-03741

DEVELOPMENT OF WATER SUPPLY TO METRO-MANILA.
Aqua, No 6, p 10-15, 1981. 5 Fig, 1 Tab.

Descriptors: *Water resources development, *Water supply, Dams, Reservoirs, Resources development, Water demand, Urban areas, *Manila, Philippines, *Metropolitan water management.

In August of 1975 the Manila Water Supply Project II began for the purpose of developing fully the present major source at Angat River, carrying out rehabilitation and extension of the water distribution system, and transforming the Metropolitan Waterworks and Sewerage System (MWSS) into an efficient public utility. The first effects of the project were recently felt with the completion of modifications to the Balara Water Treatment Plant, the partial operation of a new aquaduct, and the installation of additional distribution mains. The total Project cost is about US $416.0 million, of which $185.3 million is the estimated foreign exchange. Construction and commissioning the new La Mesa Water Treatment Plant is an integral and critical part of the Project program. Total completion and operation is scheduled for February 1982. Water to be treated at the La Mesa Plant will come from the Angat-Ipo supply system. This consists of the Angat multi-purpose dam, which discharges through power turbines to the Angat River and thence to the Ipo Diversion Dam, and then through tunnels and closed aqueducts to the Novaliches Reservoir. Prior to entering the Reservoir, the water will be diverted into an open channel to the La Mesa Treatment Plant. The new Ipo Dam is located on the Angat River near its confluence with the Ipo River in the Province of Bulacan. The dam will double the present water supply capacity to Manila. The project consists of building both the dam and the necessary flood and self-regulating radial gates and other material. (Baker-FRC)
W82-03742

A CENTURY OF EFFORT QUENCHES HONG KONG'S THIRST,
For primary bibliographic entry see Field 3B.
W82-03743

WATER SOFTENING BY CRYSTALLIZATION,
Amsterdam Waterworks (Netherlands).
I. A. Graveland.
Aqua, No 2, p 3-4, 1980. 3 Fig.

Descriptors: *Water softening, *Hardness, *Crystallization, Calcium carbonate, *Water treatment.

A water softening process uses sodium hydroxide to increase pH and cause calcium carbonate to crystallize on marble grains in a fluidized bed. Once every day or two the larger two mm grains are removed from the bottom, and new seeding sand is added. These marble grains may be used in industrial applications. Hardness is reduced from five to three meq per liter at pH 8.5. Heavy metals are almost completely removed, but organic compounds are not. Additional costs for central water softening per family in Holland are estimated at two pounds a year, with a ten pounds per year savings in washing powder and equipment maintenance. (Cassar-FRC)
W82-03750

5G. Water Quality Control

A CONTROL MODEL FOR PHOSPHORUS LOADING REDUCTION UNDER UNCERTAINTY,
Mining Development Inst., Budapest (Hungary).
I. Bogardi, L. Duckstein, and F. Szidarovszky.
Ecological Modelling, Vol 12, No 1, p 83-103, March, 1981. 6 Fig, 8 Tab, 38 Ref.

Descriptors: *Eutrophication, *Phosphorus, *Model studies, *Water quality control, Nutrients, Water quality management, Lakes, Snowmelt, Fertilizers, Erosion control, Sediment yield, Land use, *Nutrient loading control, Lake Balaton, Hungary.

An investigation into the control of nutrient loading to prevent eutrophication was made using a system model of Lake Balaton, Hungary. The model was composed of the state vector consisting of dissolved P and sediment-fixed P and the probability density (pdf) of these values. Six pure strategies concentrating on the control of point source pollution, fertilizer, erosion, land use, runoff, and sediment yield are used to define eight mixed alternatives. The measure of effectiveness of control has been taken as the relative frequency (uj) with which alternative j results in the highest loading reduction, in order to account for the stochastic character of loading. Under the data and conditions for the sub-watershed of Lake Balaton, the most effective treatment for the control of nutrient loading appears to be tertiary wastewater treatment. Stochastic models of snowmelt which may increase P-loading under no-till agricultural systems may also be used within the event-based framework of the present model. (Geiger-FRC)
W82-03421

U. N. LAUNCHES INTERNATIONAL WATER DECADE; U. S. ROLE UNCERTAIN,
G. Dallaire.
Civil Engineering (New York), Vol 51, No 3 p 59-62, March, 1981.

Descriptors: International Hydrolic Decade, Rural areas, *Public health, Sanitary engineer, Sewage treatment, *Potable water, *Waste disposal, Foreign countries, Governments, Engineering, Diseases, Water pollution, United Nations, *Water quality control, Drinking water.

Constraints to achieving the goals of the United Nations' International Water Decade are governmental commitment and motivation, managerial ability, manpower and training on all levels (from professional to laborer and handyman), appropriate technology, and money. Many developing countries consider industrial, agricultural, transportation, and power development much more important than water and sanitation. In some cases advanced technology is used to construct expensive, complicated treatment plants which cannot be maintained, whereas simple latrines or the double vault method can greatly improve sanitation. When engineering students from developing countries returned to their homelands, many took desk jobs and failed to spread their knowledge to the villages and rural areas. Although rural areas have severe problems from improper waste disposal and polluted drinking water, the problems in rapidly

growing third world cities are worse. As yet, United States consultants have not been involved significantly in these developing countries. Many have not had experience in simple, low cost technologies. The United States would benefit from involvement in the Water Decade because some diseases common to the third world are finding their way to the Western world. In addition, the developing countries supply some necessary raw materials as well as consuming American products and services. (Cassar-FRC)
W82-03449

RAPID SEWER ANALYSIS SAVES TOURIST SEASON,
M. Garbrecht.
Consulting Engineering (St. Joseph), Vol 54, No 4, p 148, 150, 152, April, 1980.

Descriptors: *Sewer infiltration, *Rehabilitation, *Cape May, New Jersey, *Water pollution control, Inspection, *Sewer systems, Maintenance.

Cape May, New Jersey, a seaside resort town with sewer service to 150,000, completed sewer inspections and repairs before the tourist season, worth more than $100 million, opened. The beaches had been closed by the state because of the high level of fecal coliforms entering the ocean and Delaware Bay from the defective system. Initial investigations covered the total collection system, 150,000 feet of mains and six pumping stations. Infiltration/inflow measurements eliminated two subsystems from study, and work concentrated on the 83,000 feet most likely to produce the remaining infiltration/inflow. Subsequent investigations concerned location of pollution from the storm drains and location of sources which caused surges and sewage treatment plant by-passing. About 35% of the infiltration/inflow sources were repairable and 42% of the manholes needed water-tight covers. All work from specifications development to major corrective work was done within six months, at a total cost less than the estimated $1.635 million. (Cassar-FRC)
W82-03494

THE EFFECT OF ARTIFICIAL DESTRATIFICATION ON PHYSICO-CHEMICAL PARAMETERS AND PHYTOPLANKTON IN HAM'S LAKE, OKLAHOMA,
Oklahoma State Univ., Stillwater.
H. N. Chau.
PhD Thesis, December, 1980. 135 p, 18 Fig, 19 Tab, 116 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-13298.

Descriptors: *Water quality, *Lakes, *Mixing, *Destratification, *Environmental effects, Nutrients, Phytoplankton, Standing crops, Physicochemical parameters, *Ham's Lake, *Oklahoma.

Physico-chemical parameters of water quality and the standing crop of phytoplankton were observed during three comparable periods in 1976, 1977, and 1978 in Ham's Lake, Oklahoma. The objective was to determine the ecological effect of artificial mixing on the lake, which was artificially mixed during 1976 and 1978, but not in 1977. The major findings were as follows. Artificial mixing created isothermal conditions by raising the temperature between the bottom and 4 m. The larger axial flow pump of 1.6 m destratified the lake better than the smaller one of 1.1 m (diameter). Artificial mixing reduced the transparency of the Secchi disc. Anoxic conditions in the hypolimnion were eliminated by artificial mixing. Artificial mixing reduced free carbon dioxide at the bottom of the lake causing an increase in pH. Free carbon dioxide at the surface did not increase, probably due to higher rates of photosynthesis. Total alkalinity was isochemical with respect to depth during mixing. The concentration of nitrate was slightly higher during experimental years. The concentration of ammonia was lower in 1978 than in 1976. The concentration of sulfide decreased during artificial mixing. Phosphate was detected more often during the experimental years. Concentrations of chlorophyll a were higher during the experimental years. Artificial mixing encouraged the growth of the diatoms, Cyclotella, Melosira, and Navicula but discouraged the blue-green algae, Microcystis and Anabaena. Horizontal variability in water quality parameters and chlorophyll a was observed at Ham's Lake. (Sinha-OEIS)
W82-03510

IRRIGATED AGRICULTURE AND NITRATE POLLUTION OF RURAL WATER SUPPLIES: ECONOMICS FOR POLICY IN CENTRAL WISCONSIN,
Wisconsin Univ.-Madison. Dept. of Agricultural Economics.
R. C. Griffin.
PhD Thesis, 1980. 333 p, 9 Fig, 10 Tab, 234 Ref. University Microfilms International, Ann Arbor, MI; Order NO GAX81-02202.

Descriptors: *Groundwater pollution, *Water pollution control, *Agriculture, *Economic aspects, Water policy, Irrigation, Nonpoint pollution sources, Agricultural watersheds, Agricultural wastes, *Nitrates.

The economic structure which characterizes the nitrate pollution of groundwater by irrigated agriculture in the Wisconsin Central Sands Region is examined. The major emphasis is the development of a theoretical and methodological framework for evaluating problems involving agricultural pollution. The primary feature characterizing agricultural instances of pollution is their 'nonpoint' nature. 'Nonpoint production functions' are used to identify the technical relationships between nonpoint pollution generation and agricultural activities. This concept leads to several alternative policy proposals as well as specific policy parameters for use in non-point situations. Two additional concerns which are related to agricultural pollution involve the spatial nature of groundwater contamination and the 'policy transaction costs' to be encountered during policy implementation and maintenance. Policy transaction costs refer to the administrative and information costs which accompany the implementation of any pollution-control policy. These costs can be substantial in nonpoint situations, and the efficiency and effectiveness of alternative policy programs is shown to be related to these costs. Current economic procedures for analyzing policies and current nonpoint policy are critiqued and found to be deficient in several regards. Needed improvements in these procedures and institutions are suggested. (Sinha-OEIS)
W82-03512

OPTIMIZING SALINITY CONTROL STRATEGIES FOR THE UPPER COLORADO RIVER BASIN,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 6B.
W82-03518

GROUNDWATER MONITORING STRATEGIES TO SUPPORT COMMUNITY MANAGEMENT OF ON-SITE HOME SEWAGE DISPOSAL SYSTEMS,
Colorado State Univ., Fort Collins. Dept. of Agriculture and Chemical Engineering.
J. D. Nelson.
PhD Thesis, 1980. 147 p, 15 Fig, 8 Tab, 76 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-22416.

Descriptors: *Water pollution prevention, *Water pollution sources, Groundwater, *Groundwater pollution, Monitoring, Domestic wastes, Septic wastewater, Mathematical models, Sampling, *Wastewater management, Septic tanks.

Organizations which provide centralized management of on-site sewage disposal systems are currently evolving in many areas of the United States. At present, there is no routine feedback for management agencies regarding their efforts in preventing ground water contamination. Ground water monitoring is necessary to provide these agencies with the information they need to maintain ground water quality. This research is directed toward supplying monitoring strategies for that purpose. Ground water monitoring strategies presented here were developed by combining deterministic and probabilistic approaches. Two types of monitoring are defined which need to be incorporated into an overall management plan. Inspection monitoring strategies are developed in terms of the sampling frequencies necessary to obtain a specific probability of detecting system failure. A mathematical model describing the flow of pollutants through the leach field is developed for the purpose of evaluating sampling plans and a sensitivity analysis is performed to determine the effect of varying the parameters of the system and the input to the leach field. The discussion of trend monitoring strategies is based primarily on existing statistical theory. Sampling frequency is discussed in terms of the number of samples required to obtain an estimate of the mean of a water quality variable within specified confidence limits. The effect of spatial and serial correlation is also considered. Finally, a discussion of various sampling techniques applicable to ground water monitoring is presented. (Sinha-OEIS)
W82-03527

ANALYSIS OF WASTE LOAD ALLOCATION PROCEDURES,
Villanova Univ., PA. Dept. of Civil Engineering.
R. A. Chadderton, A. C. Miller, and A. J. McDonnell.
Water Resources Bulletin, Vol 17, No 5, p 760-766, October, 1981. 5 Tab, 3 Ref.

Descriptors: *Waste load, *Water pollution prevention, Planning, Model studies, *Literature review, Water quality control, Regulations, *Streams, *Assimilative capacity, *Design flow.

A survey of the literature and of water resources research institutes produced 20 potential methods for calculating waste load allocations. Five of these were compared, using 25 sets of waste load allocation data. The most promising method in terms of insensitivity to basic water quality data errors was No. 1, equal percent removal or equal percent treatment. Method No. 4, effluent concentration inversely proportional to pollutant mass inflow to treatment facility, was nearly as insensitive. There were disadvantages associated with all 5 models studied in detail. No. 1 forces small volume dischargers and dilute sources to treat wastes to a higher and more expensive degree. No. 4 requires large dischargers to treat to a higher level. Waste load allocations were sensitive to variations in reaeration and deoxygenation rate constants and to pollutant source strengths and locations. (Cassar-FRC)
W82-03550

HYPOLIMNETIC AERATOR FIGHTS EUTROPHICATION,
Water and Pollution Control, Vol 119, No 10, p 24, October, 1981. 1 Fig.

Descriptors: *Lake restoration, *Eutrophication, *Aeration, Water pollution effects, Water pollution control, *Hypolimnion, Nutrients, Water pollution prevention, Water quality control, Lakes, Tertiary wastewater treatment, Population exposure, Population dynamics, *Ontario.

Free floating portable hypolimnetic aerators have been designed by a group of scientists at York University for combating eutrophication in Ontario lakes. The aerator features a riser tube of flexible polyvinyl coated nylon to resist breakage and rubber hoses to receive compressed air from the shore. One aerator can aerate the hypolimnion of a whole lake if operated long enoough. Initial testing of the apparatus has been conducted on Tory Lake and Lake St. George. By 1984, weekly followup testing including tests on the dynamics of lake aquatic species will amount to the largest study of lake aeration to date. The aerator is seen as a short-term solution to lake eutrophication due to nutrient addition from urban and agricultural runoff. The construction of tertiary sewage treatment plants and the use of modified agricultural practices are recommended to solve the problems of lake deterioration in Ontario over the long run. (Geiger-FRC)
W82-03563

REMOVAL OF HEXAVALENT CHROMIUM FROM ESTUARINE WATERS BY MODEL SUBSTRATES AND NATURAL SEDIMENTS,
Maine Univ. at Orono.
L. M. Mayer, and L. L. Schick.
Environmental Science and Technology, Vol 15, No 12, p 1482-1484, December, 1981. 5 Fig, 14 Ref.

Descriptors: *Chromium, *Sediments, *Adsorption, *Salinity, Fate of pollutants, *Estuaries, Chromates, Metals, Estuarine environment, Phosphates, Silicates, Suspended sediments, Water pollution control.

Chromate was not effectively removed by suspended sediments at concentrations typical of estuarine systems (< 1 g per liter). Removal of hexavalent Cr was studied using two model substrates, alumina and kaolinite, and natural estuarine sediments at salinities of 0 to 32 o/oo and 1 microM Cr per liter as KxCrO4. Chromate removal from seawater varied from 0.1 to 0.4 microM per liter at sediment concentrations near 0 mg per liter to about 0.5 micro M per liter at 200 mg per liter. Natural estuarine sediments were more efficient in immobilizing Cr than the model substrates. Cr removal decreased with increasing salinity in alumina and kaolinite experiments over the range 0 to 32 o/oo. Cr removal in natural sediments increased to the 0.1-1.0 o/oo salinity range and decreased with increasing salinity thereafter. The peak is similar to that seen when Cr(6+) is reduced to Cr(3+) by gallic acid at increasing salinity. This suggests a two-step sequence of reduction followed by adsorption (reductive adsorption). Naturally occurring levels of phosphate and silicate had negligible effect on chromate removal. (Cassar-FRC)
W82-03637

BIODEGRADATION OF LINEAR ALCOHOL ETHOXYLATES IN NATURAL WATERS,
Procter and Gamble Co., Cincinnati, OH.
For primary bibliographic entry see Field 5B.
W82-03638

GROUNDWATER QUALITY IMPROVEMENT THROUGH NONLINEAR DIFFUSION,
Center for Water Resources Development and Management, Trinandrum (India).
P. Basak, and V. V. N. Murty.
Journal of Hydrology, Vol 53, No 1-2, 151-159, September, 1981. 3 Fig, 10 Ref.

Descriptors: *Mathematical equations, *Water quality management, *Groundwater pollution, *Diffusion coefficient, Mathematical studies, Mathematical models, Water pollution control, Water quality control, Permeability, *Groundwater.

At the present, no formal analytical solution has been offered for the problem of gradual improvement of groundwater quality by diffusing the contaminant to the adjoining less contaminated source. An effort was made to develop an analytical solution to this problem with constant and concentration-dependent diffusivities. When the diffusion coefficient (D) is assumed to be constant, the governing differential equation is linear. When D is assumed to be concentration-dependent, the governing equation becomes nonlinear. Since the difference between the exact solution of the concentration-dependent diffusion and the linearized solution for diffusion is negligible, the use of the simplified linearized solution is recommended for all practical purposes. The nonlinearized solution to the problem of gradual improvement of groundwater quality by diffusing the contaminant should be used when greater accuracy is required. (Geiger-FRC)
W82-03652

VINYL LINED ASBESTOS CEMENT PIPE PROBLEMS-HEALTH ASPECTS,
Dept. Environmental Quality Engineering, MA.
For primary bibliographic entry see Field 5F.
W82-03663

SIMULATING COAL PILE RUNOFF AS A DESIGN TOOL,
For primary bibliographic entry see Field 5B.
W82-03692

EFFECTS OF A BARRAGE ON FLUSHING AND WATER QUALITY IN THE FITZROY RIVER ESTUARY, QUEENSLAND,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 4A.
W82-03705

RETROSPECTIVE ANALYSIS OF WATER SUPPLY AND WASTEWATER POLICIES IN PITTSBURGH, 1800-1959,
Carnegie-Mellon Univ., Pittsburgh, PA. Coll. of Humanities and Social Sciences.
For primary bibliographic entry see Field 5D.
W82-03721

AN ECONOMIC APPROACH TO GROUND WATER QUALITY MANAGEMENT,
California Univ., Davis. Dept. of Agricultural Economics.
R. E. Howitt, and P. Mean.
In: Proceedings of the Thirteenth Biennial Conference on Ground Water, Irvine, September, 14-15, 1981. California Water Resources Center, University of California, Davis, Report No 53, November, 1981. p 103-113. 2 Fig, 3 Tab, 4 Ref.

Descriptors: Degradation, *Saline soils, *Crop yield, Aquifers, Percolation, *Economic aspects, Soil types, Salt balance, Leachates, Social costs, Water costs, Perched groundwater, Recharge, Agricultural hydrology, Hydrologic models, Agriculture, *Groundwater management, *Water quality control, Aquifer management.

Groundwater quality degradation, particularly salinity increases, seriously affect costs to agricultural, municipal and industrial users. This paper discusses the economic aspects in the agricultural sector and centers on two themes: (1) that farmers can take actions to offset much of the cost of expected salinity increases over the next 20 years: and (2) that the reactions of farmers to physical and economic changes must be considered when planning salinity reduction projects. Salinity mitigation actions include crop rotation, blending water sources, and using varied irrigation methods. Several factors that will affect farmers' reactions to increased salinity are the long run vs. short run costs and the timing of any remedial action. Salinity buildup is inevitable without remedial action; therefore, optimal economic management of an aquifer requires that both long and short run costs of salinity buildup be equated to remedial costs at any given time. An economic hydrologic model was built at one of two Kern County study sites and the most pertinent result showed that the cost of groundwater salinity degradation increases over time keeping other factors constant. Lag time, or memory, of salts percolating into the aquifer was omitted from the model, but is is generally believed that the time lags of salinity are very long and that the timing of remedies is crucial. The major long run cost of increased salinity is soil permeability rather than the intermediate cost of soil depression. Groundwater salinity is a common pool problem and all users must contribute to the solution. (Atkins-Omniplan)
W82-03732

COMMENTS ON A NATIONAL GROUNDWATER PROTECTION STRATEGY,
For primary bibliographic entry see Field 6F.
W82-03740

FLOW-AUGMENTATION AND WATER QUALITY IN PARAIBA DO SUL RIVER BASIN-BRAZIL,
C. Celso do Amaral e Silva.
Water Science and Technology, Vol 13, No 3, p 43-48, 1981. 2 Fig, 2 Ref.

Descriptors: *Water quality control, *Energy loss, *Minimum flow, *Flow augmentation, *River basins, Paraiba River, *Brazil, Model studies, Rivers, Multireservoir networks, Water pollution control, Reservoirs, Mathematical models, Computer models.

The DOSAGM model and the Multi-Reservoir model were applied to the South Paraiba River basin to study pollution control. Minimum flow was maximized at various points in the system. Optimum operation is based on comparisons between the cost necessary for waste treatment and the costs resulting from increases in minimum flow. A graph depicts the system energy loss in percent as a function of the minimum flow (cu meters per sec) at any point. Zero energy loss occurs at a flow of 45 cu meters per sec and 60% at 75 cu meters per sec. (Cassar-FRC)
W82-03744

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

WATER SUPPLY RELIABILITY THEORY,
Technion - Israel Inst. of Tech., Haifa. Dept. of Civil Engineering.
U. Shamir, and C. D. D. Howard.
Journal of the American Water Works Association, Vol 73, No 7, p 379-384, July, 1981. 15 Fig, 2 Tab, 2 Ref.

Descriptors: *Reliability, *Mathematical analysis, *Water supply, Statistical methods, Maintenance, Water demand, Economic aspects, Water storage, Pumping.

Mathematical functions are used to describe water supply reliability and to develop a framework for its economic assessment. The analysis is based on demand being fixed and known, while future work will have to deal with the random nature of both demand and supply. A comprehensive statistical description of reliability can be developed by defining a reliability factor that is a function of the relative shortfall during a failure or over some period of time. The required data is usually readily available in the maintenance records of water supply companies, as interfailure times and repair durations are the only data needed. Also, a procedure can be developed to determine which expansion alternative provides the desired reliability. This procedure is demonstrated for the alternatives of additional storage versus standby pumping capacity. Reliability can be increased by adding facilities, storage, pumping capacity, and pipelines, and this procedure can be used to identify the least cost combination of facilities. (Small-FRC)
W82-03432

OUTLOOK FOR WATER AND WASTEWATER SYSTEMS, PROCESSES, AND EQUIPMENT: COMMENTS FROM MALCOLM PIRNIE, INC., WHITE PLAINS, NY,
R. F. Bonner.
Water/Engineering and Management, Vol 128, No 3, p 63-64, March, 1981. 1 Fig.

Descriptors: *Wastewater treatment, *Projections, *Energy conservation, Wastewater facilities, Performance evaluation, Equipment, Sludge thickening, Sludge drying, Sludge digestion, Sludge conditioning, Aeration.

As a result of the change in the relationship of the relative costs of labor, chemicals, and energy, in addition to the possible unavailability of energy, energy reduction and savings will be the designer's focal point in choosing and specifying processes, systems, and equipment for wastewater treatment plant construction, whether new, retrofitted, or expanded. This is particularly true in metropolitan areas with large plants. As a result, the sludge handling and disposal processes and the aeration facilities, both of which are major consumers of energy, will be investigated intensively for ways to reduce energy usage. Various processes for thickening, digesting, conditioning, dewatering, and incinerating sludge which provide energy savings are currently under investigation. The addition of

waste heat recovery systems is also being explored. Aeration is the prime power user for the liquid portion of the wastewater treatment system, regardless of the technique selected. Choice of the particular method should be carefully investigated with respect to the type of waste to be treated. (Carroll-FRC)
W82-03474

OUTLOOK FOR WATER AND WASTEWATER SYSTEMS, PROCESSES, AND EQUIPMENT: COMMENTS FROM GILBERT/COMMONWEALTH, READING, PA,
J. E. Germaine.
Water/Engineering and Management, Vol 128, No 3, p 62, 63, 69, March, 1981.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Projections, Management planning, Water treatment, Sludge drying, Energy conservation, Energy, Conservation.

A variety of projections with respect to water and wastewater systems, processes, and equipment are presented. A continued slow demand for wastewater and water treatment equipment and facilities is expected in the near future, followed by a slight increase and leveling off as more wastewater projects move from current planning phases to construction and as increased water demands necessitate expansion of water supplies. Energy conservation considerations can be expected to continue to have a significant impact on capital investment decisions. The Environmental Protection Agency's emphasis on innovative and alternative systems and on consideration of on-lot wastewater disposal as an alternative to wastewater plants will affect equipment and facility selections and decisions in the wastewater treatment field. The use of the rotating biological contactor in the liquid process train of wastewater treatment facilities and of the belt filter press in the sludge train can be expected to increase. Rehabilitation of old water treatment systems will become increasingly urgent in the coming years. Pursuance of the goals of the United Nation's Water Decade should result in a large international market for basic equipment and services, particularly in rural areas. If water and wastewater facilities are to meet future needs, manufacturers will have to reestablish high standards for equipment quality and manufacturer service. (Carroll-FRC)
W82-03475

NUMERICAL SIMULATION OF RESERVOIRS,
Brown Univ., Providence, RI. Div. of Applied Mathematics.
M. C. Michaud.
PhD Thesis, June, 1980. 124 p, Numerous Illust, 10 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-11146.

Descriptors: *Mathematical models, *Mathematical studies, Algorithms, *Fluid mechanics, *Reservoirs, Flow.

The numerical methods presented have been developed for use in problems of fluid mechanics with flows that display shocks, shear layers or steep fronts. An area of particular interest is multiphase flow of oil, water and often other phases in an oil or natural gas reservoir. These reservoirs are discussed including their properties and some of the particulars of water flooding. Numerical methods for reliable simulation of the fluid motion of oil and water in waterflooding of a reservoir are exaplained and discussed. A simplified saturation equation is used as a model of two-phase flow in a porous medium. The techniques presented are applicable to the kinds of multiphase flows that are important in other secondary and tertiary recovery methods. The basic algorithm used is the biased difference algorithm. It has been modified to take into account the shape of the fractional flow rate equation. With this simple modification, the midpoint method, the results obtained were good for reasonable ranges of diffusion constants. The midpoint method is a first approximation in an iterative scheme which could be further improved for more precise results. The savings in computation and storage gained by using selective grid refinement versus recomputing the problem on a fine grid will be more pronounced in the three-dimensional case. Selective grid refinement is expected to be applicable in a wide variety of problems with shear layers or steep shocks. (Sinha-OEIS)
W82-03504

INVESTMENT ALTERNATIVES IN CASES OF EXTENDED WATER SUPPLY SHORTAGES IN CITIES OF DEVELOPING COUNTRIES,
Cornell Univ., Ithaca, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 6D.
W82-03507

GENERALIZED STORAGE-YIELD RELATIONSHIPS FOR SURFACE WATER RESERVOIRS ON NORTHEASTERN UNITED STATES' WATERSHEDS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
T. Haktanir.
PhD Thesis, May, 1980. 484 p, 31 Fig, 21 Tab, 66 Ref, 14 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-24450.

Descriptors: *Water supply, *Reservoirs, *Storage reservoirs, *Economic aspects, Model studies, Water Shortage, Watersheds, Urban areas, Economic yield, Water yield, Comparison studies, *Northeastern United States.

Utilizing 500-year-long synthetic data generated from 37-year-long historical data, yield versus storage capacity relationships were determined by a hydrologic model within 95% confidence limits on all the arbitrarily chosen 50 natural streams of various sizes in the study area. This model simulated the operations of an urban water supply reservoir, accounting for streamflows, lake evaporation loss, lake precipitation gain, and loss of storage by sedimentation. Although the statistical model did not account for lake evaporation and precipitation and sedimentation, the results obtained by the statistical formula utilizing the actual 37 years of historical data were observed to be in plausible agreement with those of the hydrologic model at 97.5% probabilities. An economic model, utilizing the empirically derived cost functions for reservoir costs and water shortage costs from the available data in the study area, searched for optimum urban water supply reservoirs by weighing the trade-offs between reservoir costs versus water shortage costs from smaller reservoirs and revealed the quasi-yield versus optimum storage capacity relationships. On the basis of the total costs from the optimum reservoirs at yields between 10 and 100 percent of the average streamflow, a marginal costs analysis showed economically feasible yield levels, which in the study area were found to be between 50 and 70 percent of the average streamflow. (Sinha-OEIS)
W82-03523

MATHEMATICAL MODELING OF EARTH DAM BREACHES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W82-03532

INVESTIGATING WHETHER A LARGE HYDRO DEVELOPMENT CAN BE ENVIRONMENTALLY COMPATIBLE: THE SLAVE RIVER HYDRO FEASIBILITY STUDY,
Walker (R. L.) and Partners Ltd., Ottawa (Ontario).
B. Grover, and C. Primus.
Canadian Water Resources Journal, Vol 6, No 3, p 47-62, 1981. 2 Fig, 3 Ref.

Descriptors: *Hydroelectric plants, *Environmental effects, *Feasibility studies, *Slave River, *Alberta, Electric powerplants, Economic aspects, Dam construction, Project planning, Planning, Reservoirs, Lamprey, Mercury, Water resources development.

This paper discusses the principles used in studying the environmental effects of a possible 2000 megawatts development on the Slave River, Alberta. These principles are: (1) environmental considerations should be included from the beginning of project planning and evaluation, (2) environmental consequences can be positive as well as negative, (3) power projects should be evaluated in a systems context, i.e., alternative sites must be included in the planning process, (4) the scale of a project is no indication of its efficiency or environmental impact, and (5) preconceived constraints should not enter into planning at the initial stages. The provisional findings of a feasibility study indicate that the Slave River development is technically feasible and economically attractive. A single stage development is more economical than two smaller developments. Four possible environmental concerns are leakage of the reservoir through karstic formations, spread of the Arctic lamprey upstream, increases in the naturally high mercury levels of Lake Athabasca, and the most environmentally acceptable location for a transmission system. (Cassar-FRC)
W82-03615

HIGHLIGHTS OF THE ST. MARY'S REDEVELOPMENT PROJECT,
For primary bibliographic entry see Field 8A.
W82-03617

SWMM MODEL AND LEVEL OF DISCRETIZATION,
College of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
N. A. Zaghloul.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1535-1545, 1981. 8 Fig, 8 Ref.

Descriptors: *Runoff, *Hydrographs, Simulation, *Model studies, Design criteria, Planning, Catchments, Computers, Flow, Rainfall, Rainfall-runoff relationships, Storms, *Urban areas, *Flow profiles.

The accepted level of discretization used for flow simulation over an urban area was investigated, and the effect of reducing the number of subcatchments on the accuracy of runoff simulation was studied. Methodology is defined to achieve a representative equivalent catchment from theoretical considerations. Verification of the procedures involved a series of applications on both hypothetical and real areas. The simulation results of the simplified (coarse) discretization are compared with those of the detailed (fine) discretization of the same rainfall storms. The accuracy of the simulation is maintained by careful aggregation of the subcatchment parameters and proper selection of the aggregated hydraulic width. It was concluded that surface runoff hydrographs generated from both the detailed subcatchments and the aggregated equivalent catchment will be similar. The weighted average properties of the detailed sewer system will provide an aggregated equivalent transport system. In the proposed simplified simulation using a single catchment and the Runoff Block, the hydraulic width of the single catchment should be reduced to account for the loss in conduit storage by increasing surface storage. The accuracy of the simulation using the Runoff and Transport Blocks and the simplified procedure using only the Runoff Block is maintained by careful aggregation of the subcatchment parameters and proper selection of aggregated hydraulic width. Conduit routing for small areas proved insignificant. The SWMM simulation using coarse discretization will result in reducing setting up and computer costs. (Baker-FRC)
W82-03673

MODELING THE ECONOMICS OF GROUND WATER MANAGEMENT,
Auslam and Associates, Inc., Sacramento, CA.
For primary bibliographic entry see Field 4B.
W82-03733

6B. Evaluation Process

DESIGNING AN ENERGY-EFFICIENT WASTEWATER TREATMENT PLANT.
For primary bibliographic entry see Field 5D.
W82-03477

OPTIMIZING SALINITY CONTROL STRATEGIES FOR THE UPPER COLORADO RIVER BASIN,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
R. G. Evans.
PhD Thesis, 1981. 314 p, 37 Fig, 14 Tab, 139 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-19700.

Descriptors: *Water quality control, *Cost benefit analysis, Economic aspects, Salinity, Desalination, Agricultural runoff, Nonpoint pollution sources, Resources development, *Colorado River Basin.

Salinity is the most serious water quality problem in the Clorado River Basin. To offset salinity caused by the development of the vast energy supplies and to allow the seven Colorado River Basin states to fully utilize their allocation of Colorado River water, it is necessary to implement cost-effective salinity control programs in the basin. A simple multi-level nonlinear optimization procedure was utilized to formulate the most cost-effective array of salinity control strategies for the Upper Colorado River Basin. The incremental cost-effectiveness methodology qualitatively indicates the location and general type of alternatives to be implemented in a least cost basin-wide salinity control program. The results also qualitatively indicated the anticipated salt load reduction and expected annual costs of each salinity reduction increase for any preselected level of control. Cost-effectiveness functions were developed for each of the major canals and laterals, the aggregate laterals under each canal, and an array of on-farm improvements for each agricultural project area. Similar functions were also developed for point sources such as Paradox Valley, Glenwood-Dotsero Springs and Crystal Geyser. Collection and desalination of agricultural return flows were also considered. Optimal salinity control programs are presented for the individual alternatives, for individual areas or projects, for the states of Colorado and Utah and the Upper Colorado River Basin. (Sinha-OEIS)
W82-03518

THE DIFFUSION OF TECHNOLOGY IN THE NINETEENTH CENTURY AMERICAN CITY: MUNICIPAL WATER SUPPLY INVESTMENTS,
Northwestern Univ., Evanston, IL.
L. D. Anderson.
PhD Thesis, June, 1980. 241 p, 2 Fig, 28 Tab, 237 Ref, 418 Footnotes. University Microfilms International, Ann Arbor, MI; Order No GAX80-26758.

Descriptors: *Municipal water, *Water supply, *Economic aspects, Investment, History, Social aspects, Benefits, Evaluation, Technology, Nineteenth Century, United States, New England.

The degree of economic rationality with which water supply decisions were made, particularly after 1870, are investigated. The technology of water works construction is examined and improvements in technology which reduced the risk of system failure are described. Changes in cities' perceptions of the potential benefits of water works construction are examined. Better health and less fire damage are the major ones, but the attraction of industry, hopes of future prominence, and municipal pride also motivated water works investments. The role of public health organizations in fostering water works construction is described, as is the effect of increasing medical knowledge about disease. The process by which many small towns obtained water works after 1870 can be described as the diffusion of technology. The general characteristics of diffusion models are discussed, and a limited model is treated with data on the diffusion of water works in New England. Finally, the economic rationality of decisions to construct water works is examined. Social benefits are estimated using fire insurance rate differentials as a measure of expected savings from fire damage. Using these benefits and reported cost of construction, the internal rate of return to water works investments is computed. It is demonstrated that the internal rate of return was substantially higher than the cost of capital, and that the long run advantage of water works over wells is quite large. (Sinha-OEIS)
W82-03537

POTENTIAL IMPACT OF IRRIGATION ON WATER RESOURCES IN THE LITTLE WABASH BASIN OF ILLINOIS,
Illinois Univ. at Urbana-Champaign.
For primary bibliographic entry see Field 6D.
W82-03547

REPLACING LARGE WATER METERS: WHY AND HOW,
Rockwell International, Atlanta, GA.
For primary bibliographic entry see Field 5F.
W82-03560

WATER METERING AND CONSERVATION,
Council of Economic Advisors, Washington, DC.
For primary bibliographic entry see Field 3D.
W82-03562

TREATING INFILTRATION AT ITS SOURCE REDUCES CAPITAL COSTS.
For primary bibliographic entry see Field 5D.
W82-03564

CURRENT ASSESSMENT OF PROSPECTS FOR FURTHER HYDRO DEVELOPMENT IN CANADA,
Walker (R. L.) and Partners Ltd., Ottawa (Ontario).
J. H. Diddens.
Canadian Water Resources Journal, Vol 6, No 3, p 63-83. 1981.

Descriptors: *Hydroelectric power, *Environmental effects, *Energy sources, Powerplants, *Cost analysis, Electric powerplants, Electric power costs, Costs, *Canada, Water resources development, Nuclear powerplants, Coal, Economic aspects, Planning, Fuel.

Sites for small hydroelectric plants (1 to 10 MW) in Canada are economically attractive only if certain conditions exist, for example, in an isolated location where fuel costs are high. The cost of investment and transmission is currently $10,000 per KW and varies widely according to site cost of alternative fuels, load factors, operating costs, variability of load, and supply requirements. Since the cost of electricity from large system is $1,000 to $3,000 per KW, new small hydroplants cannot generally compete. However, rehabilitation of old systems and pumped storage arrangements may make hydro projects more attractive. Constraining factors include the reluctance of a large power organization to deal with management of a string of small plants, problems with control and technical questions about price, and high engineering and environmental assessment costs. This paper compares the economic aspects and environmental effects of several types of power generation: oil, coal, gas, nuclear, hydroelectric, and innovative technologies. Major factors in the use of alternative power generation methods are the escalating costs, especially of oil; land destruction and acid emissions connected with coal; large reserves and easy transmission of gas; and public concern over long-term effects of nuclear plants. Hydropower, on the scale of thousands of MW, will continue to be the main focus in the Canadian power industry. As the large sites are developed, attention will turn to low head sites with capacities of hundreds of MW. (Cassar-FRC)
W82-03620

DICKSON DAM, ALBERTA - THE 20 MW POWER FACILITY,
For primary bibliographic entry see Field 8A.
W82-03621

WATER QUALITY: WHAT SHOULD BE DONE TODAY,
National Resources Defense Council, Inc., Washington, DC.
For primary bibliographic entry see Field 6E.
W82-03631

UPGRADING TO INCREASE TREATMENT CAPACITY,
Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5F.
W82-03654

ASSESSMENT OF CURRENT AND PROSPECTIVE FOUNDATIONS OF WATER RESOURCES PLANNING,
Nebraska Univ.-Lincoln.
A. H. Chan.
PhD Thesis, May, 1981. 362 p, 26 Fig, 7 Tab, 230 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-24508.

Descriptors: *Water resources development, *Planning, *Economic aspects, Project planning, Cost-benefit analysis, Water supply development, Social aspects, Methodology.

This effort focuses on the philosophic, ideological, and theoretic foundations of water planning. Its intent is to assess the current planning methodology in terms of goal fulfillment. Examination of the current approach uncovers a number of problem areas. First, traditional water planning has been limited to development projects. The process of planning for a project involves locating a suitable site, designing the structure, and evaluating the economic feasibility. The aggregate of these projects constitutes the existing U.S. water resources policy. This approach of planning-by-project suffers from a lack of comprehensiveness, coherence, coordination, and consistency. Secondly, embodied in this approach is a planning methodology which has been benefit-cost analysis as the center piece. Thirdly, benefit-cost analysis focuses exclusively on economic (monetary) values established through the market when evaluating project feasibility. This study demonstrates the inadequacy of the current approach for proper goal achievement. Any competing approach hoping to replace the one presently in use needs to possess certain attributes. They include the ability to generate a definitive statement of social aspirations, to evaluate existing conditions in accordance with established goals, and to accurately account for the system and the process. This study outlines the foundations of a prospective methodology which takes a broad view of planning, incorporating knowledge from a variety of disciplines while taking into consideration various aspects of the society and its culture; it indicates the appropriate stages of an alternative planning process; and provides a framework in an orderly and comprehensible form. (Sinha-OEIS)
W82-03713

THE AGRICULTURAL BENEFITS OF SALINITY CONTROL ON THE RED RIVER OF TEXAS AND OKLAHOMA,
Texas A and M Univ., College Station.
D. H. Laughlin.
PhD Thesis, December, 1980. 292 p, 14 Fig, 38 Tab, 71 Ref, 8 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-08023.

Descriptors: Economic aspects, Cost-benefit analysis, *Economic feasibility, *Agriculture, Irrigation, *Saline water, Chlorides, Computer programs, *Saline water control, Crop production, Texas, Oklahoma, *Red River.

Salinity of the waters from the Red River and its major tributaries has virtually eliminated its use for irrigation of agricultural crops in Texas and Oklahoma. A chloride control project has been proposed whereby the source salt waters will be cap-

tured and diverted to storage facilities. The purpose of this study was to estimate the net direct benefits to agricultural producers attributable to the proposed salinity control project. Further, estimates of project costs, municipal and industrial benefits and benefits from improving the water in Lake Kemp were obtained to complete a benefit-cost analysis. The procedure used to estimate agricultural benefits was to use a FORTRAN program to develop initial tableaus of a recursive linear programming model representing agricultural production in the study area. Alternative scenarios involving profit maximizing behavior on the part of producers, current cropping patterns, and with and without SAR crop yield effects were developed to provide a range of benefit estimates. Benefit-cost analysis indicated that the proposed project was economically feasible under assumptions of all scenarios considered except where current cropping patterns were followed for the entire analysis period. (Sinha-OEIS)
W82-03729

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

METERING PROBLEMS AND METER MANAGEMENT IN TUNISIA (LES PROBLEMES DU COMPTAGE ET LA GESTION DES COMPTEURS EN TUNISIE),
Societe Nationale d'Eploitation et de Distribution des Eaux (Tunisia).
A. Frih, and M. Benaicha.
Aqua, No 3, p 267-270, 1981. 5 Tab, 6 Ref.

Descriptors: *Water metering, *Utilities, *Water rates, Water distribution, Public utility districts, *Tunisia, Monitoring.

Two types of watermeters are in use in Tunisia: the volumetric and the rate of flow. The SONDEDE (Societe Nationale d'Exploitation et de Distribution des Eaux) supplies 385,000 metered customers with a total of 120 million cu meters yearly. Meter management includes checking on all subscribers to acquire statistics and to ensure correct metering and billing, and reducing waste by means of a progressive price structure. Subscribers are notified if unusually high consumption is registered. All those with meters $>$ 30 mm in diameter and who use $>$ 500 cu meters per quarter are monitored for meter overloads or unusually low readings. The 23 heavy users, accounting for 9.2% of consumption, are subjected to more thorough checks with monthly meter reading and state of the meter inspection. Time intervals for maintenance of 5 year minimum and 10 year maximum were determined by sampling in three large towns. (Cassar-FRC)
W82-03456

6D. Water Demand

WATER SUPPLY RELIABILITY THEORY,
Technion - Israel Inst. of Tech., Haifa. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-03432

INVESTMENT ALTERNATIVES IN CASES OF EXTENDED WATER SUPPLY SHORTAGES IN CITIES OF DEVELOPING COUNTRIES,
Cornell Univ., Ithaca, NY. Dept. of Civil and Environmental Engineering.
B. U. Anyata.
PhD Thesis, August, 1980. 275 p, 49 Fig, 23 Tab, 79 Ref, 3 Append. University Microfilm International, Ann Arbor, MI; Order No GAX81-02898.

Descriptors: *Water supply, *Water supply systems, *Water shortage, *Mathematical models, Water distribution, Cost-benefit analysis, Developing countries, Rationing, Water use limitation.

In developing countries, cities commonly experience severe water shortages as a result of demands created by a rapidly growing population. The growth of the population of urban areas is caused by massive migrations from rural to urban areas and high birth rates. Population increases due to migration alone tend to overwhelm the available water supply resulting in water supply systems that are required to operate under 'deficit' conditions. Rather than operating on an intermittent basis, alternative operating strategies and design procedures to mitigate the adverse effects of water deficits associated with different types of distribution systems are examined and evaluated. Mathematical programming techniques were used to evaluate various design alternatives with pumping costs used as a surrogate for the operating costs of water distribution systems. The rate at which water is supplied to the users is the principal determinant of the cost of the system and the least costly systems are those which have the lowest flow rates. Among the various measures of controlling flow, valving systems appear to be the most cost-effective. (Sinha-OEIS)
W82-03507

THE NILE - ONE RIVER AND NINE COUNTRIES,
High Aswan Dam Authority, Cairo (Egypt).
For primary bibliographic entry see Field 4A.
W82-03545

POTENTIAL IMPACT OF IRRIGATION ON WATER RESOURCES IN THE LITTLE WABASH BASIN OF ILLINOIS,
Illinois Univ. at Urbana-Champaign.
J. W. Eheart, and A. E. Libby.
Water Resources Bulletin, Vol 17, No 5, p 851-856, October, 1981. 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Water demand, *Irrigation effects, Economic aspects, Water supply, *Cost-benefit analysis, Water shortage, Water policy, Prices, Corn, *Little Wabash Basin, *Illinois.

An economic analysis of irrigation demands vs. prices of corn (Zea mays L.) in the Little Wabash basin, Illinois, showed that rising corn prices would make irrigation more profitable to the extent that water shortages would occur. At $3.50 per bushel, no irrigation is predicted. Between $3.50 and $6.50 irrigation is likely for a small region supplied with good quality groundwater. Above $6.50-$7.50 irrigation is profitable in the entire basin using impounded water. Possible shortfalls, where potential water demand exceeds supply, are 2-20% for a price of $3.50-$6.50 and about one-third at prices above $7.50. Although there has been little crop irrigation in the basin to date, it would probably follow the general trend of increasing irrigated acreage in Illinois. These findings suggest that the State of Illinois should begin developing policies for controlling withdrawals of natural waters before large capital investments in irrigation equipment are made. (Cassar-FRC)
W82-03547

GROUNDWATER QUALITY IN VISAKHAPATNAM BASIN, INDIA,
Andhra Univ., Waltair (India). Dept. of Geophysics.
V. V. J. Sarma, and A. N. Swamy.
Water, Air, and Soil Pollution, Vol 16, No 3, p 317-329, October, 1981. 6 Fig, 3 Tab, 16 Ref.

Descriptors: *Water quality, *Water use, *Visakhapatnam Basin, *India, Groundwater potential, Domestic water, Drinking water, Industrial water, Irrigation water, Saline water, Water hardness, Chemical composition, Developing countries.

The chemical nature of groundwater in the 148 sq km Visakhapatnam Basin, India, was investigated to determine its suitability for domestic, irrigation, and industrial purposes in this rapidly developing region. Almost half the wells produced water which exceeded the World Health Organization recommended upper limits for chloride, sulfate, fluoride, Mg, Ca, and/or total hardness. In some cases pollution from industrial wastes and sewage caused the high mineral levels; in others, saltbearing formations. Most of the well samples ranged from medium to very high salinity and low to very high Na content. Water quality varied considerably from the good water along the foothills to unsuitable water in the plains. As measured by the residual carbonate factor, 51% of the samples were considered safe for irrigation ($>$ 1.25 meq per liter), 12% were marginal, and 37% were unsuitable ($<$ 2.5 meq per liter). Industrial water quality requirements vary considerably, but most of the water is too hard for use as boiler feed water. (Cassar-FRC)
W82-03552

POLISH WATER MANAGEMENT--STRUCTURE, PROBLEMS AND RESEARCH,
M. Metler.
Effluent and Water Treatment Journal, Vol 21, No 10, p 456-459, October, 1981. 1 Fig, 1 Tab.

Descriptors: *Water management, *Planning, *Poland, Resources management, Water quality, Water treatment, Water requirements, Water use.

While Poland would appear to have adequate water resources, the usable, available resources are considerably less than would be estimated at first glance. Also problematic is the fact that the water is not distributed uniformly, either geographically or seasonally. The non-returnable water consumption for the year 2000 is estimated at 10 billion cubic meters, and it follows that without a significant increase in reservoir capacity, the existing maximum for non-returnable water consumption of 7 billion cubic meters will be exceeded by a substantial margin. The volume of municipal sewage and industrial effluent discharged into Polish rivers continues to increase rapidly, and the present state of treatment is unsatisfactory. Regulations currently in force in Poland divide water quality into three categories according to the intended use. The water quality surveillance system has determined constant deterioration in the quality of water resources during the past 20 years, and it is now considered to have reached an unsatisfactory level. At present the day to day coordination and supervision of water management and environmental protection matters is in the hands of 49 Provincial Presidents and the local authorities for each separate administrative area. This makes the control spread out into too many different hands and leads to confusion and little forward motion. A research program has been undertaken to improve the situation. Specific areas of concern include studies on the influences of pollution on water quality, technological methods of effluent treatment and sludge processing, and criteria and technological solutions leading to the prevention of water pollution. (Baker-FRC)
W82-03633

BAYANIHAN, THE SPIRIT BEHIND THE PHILIPPINE WATER SUPPLY DEPARTMENT SCENE.
For primary bibliographic entry see Field 5F.
W82-03741

DEVELOPMENT OF WATER SUPPLY TO METRO-MANILA.
For primary bibliographic entry see Field 5F.
W82-03742

GLOBAL FUTURE: TIME TO ACT. REPORT TO THE PRESIDENT ON GLOBAL RESOURCES, ENVIRONMENT AND POPULATION.
Council on Environmental Quality, Washington, DC.
For primary bibliographic entry see Field 6E.
W82-03747

6E. Water Law and Institutions

WILL EPA'S NATIONWIDE URBAN RUNOFF STUDY ACHIEVE USEFUL RESULTS,
Colorado State Univ., Fort Collins, Dept. of Civil Engineering.
G. F. Lee, and R. A. Jones.
Civil Engineering (New York), Vol 51, No 9, p 86-87, September, 1981.

Descriptors: *Urban runoff, *Water quality, Runoff, Urban drainage, Storm runoff, Water pollution sources, *Regulations.

About 30 different studies are being conducted in cities across the US in a Nationwide Urban Runoff Program, under the guidance of the EPA. The studies are attempting to determine whether large amounts of money spent in domestic and industrial wastewater treatment will bring about any improvement in receiving water quality due to the high contaminant loads concentrations arising from urban stormwater drainage. The most significant deficiency seen in the current program is the failure of those responsible for developing these studies to properly consider how chemical contaminants cause impairment of beneficial uses of water. Since many chemical contaminants exist in aquatic systems in forms which are not available to affect water quality, the total concentration of a chemical in a water cannot be used as a basis for developing cost-effective, technically valid, environmentally protective programs for its control. The amounts of available forms of chemical contaminants in a water sample cannot in general be determined by direct chemical analysis, but must use bioassay techniques. The fact that bioassays are not required in the National Urban Runoff Program studies is viewed as a serious shortcoming. The water quality standards used for urban stormwater drainage must be directed toward the concentrations of available forms of contaminants rather than the total concentrations, and must allow consideration of the length of time that concentrations of available forms exceed the critical concentrations for any duration of exposure at each site of concern, as well as the impact of those couplings on beneficial uses of the waters in question. Management programs should focus on the control of the sources contributing concentrations of contaminants most likely to directly affect the useable characteristics of the receiving waters. (Baker-FRC)
W82-03424

HOME RULE WETLANDS PROTECTION IN MASSACHUSETTS: LOVEQUIST V. CONSERVATION COMMISSION OF THE TOWN OF DENNIS,
K. W. Brown.
Boston College Environmental Affairs Law Review, Vol 9, No 1, p 103-131, 1980/1981. 150 Ref.

Descriptors: *Wetlands, Home rule, *Legislation, *Water law, Permits, *Judicial decisions, Zoning, *Massachusetts, Lovequist vs. Dennis, Road construction, Legal aspects, Construction, Local governments, Jurisdiction, State governments, Governments.

Although several federal statutes concern wetlands protection, responsibility for such regulation is mainly in the state domain. The Massachusetts Wetlands Protection Act of 1972 (WPA), the Zoning Act, and the state earth removal statute give substantial statutory authority over local wetlands to municipalities. All these laws have drawbacks, and municipalities have turned to enacting wetlands regulations under home rule. The Massachusetts Supreme Judicial Court Decision Lovequist v. Conservation Commission of the Town of Dennis said that state laws did not preempt wetlands regulation from home rule enactments. In this case the plaintiffs wanted to build an access road over a marsh to an adjacent upland. The Town of Dennis denied the permit and was challenged in court. There are several differences between the Dennis by-law and the state statutes. The Dennis by-law required a local permit for wetlands alteration in addition to the one required by the Wetlands Protection Act. If the development would affect erosion, wildlife, recreation, or esthetics (not covered in the WPA), the permit could be denied or conditions imposed on the work. The Lovequist decision illustrates a liberal approach to home rule environmental protection which does not jeopardized a state's authority of legislation. (Cassar-FRC)
W82-03450

WATER QUALITY AND THE EEC,
A. K. Galloway.
Water Services, Vol 84, No 1008, p 108-110, February, 1980. 1 Fig.

Descriptors: *Water quality, *International agreements, Planning, Organizations, Administrative agencies, Water resources institutes, Water management, Water quality management, Water quality standards, Water quality criteria, Water pollution prevention.

Ten EEC directives or decisions relating to water quality have been issued, covering discharge of dangerous substances, surface water intended for abstraction for drinking, bathing water, titanium dioxide wastes, freshwater fisheries, methods of sampling and analysis, and underground water. A proposal for an EEC directive must come from the Commission, but a directive may only be adopted by the Council of Ministers. In order to ensure final unanimity at the Council level a good deal of negotiating and discussing on the form and content of the directive is necessary. At this stage national authorities will consult the interests affected by the proposals and each member state will formulate the line which it will take in the discussions. The method used to identify the waters to which a given directive will apply is not always the same for each directive. In some cases the choice of waters affected by the directive is up to the individual member states. If a directive requires that certain conditions be met, for example in the quality of bathing water along the beaches, and the particular countries involved cannot meet the deadline established, there are provisions for obtaining extensions. (Baker-FRC)
W82-03472

THE EVOLUTION OF WATER QUALITY MANAGEMENT,
R. D. Hennigan.
Clearwaters, Vol 10, No 1, p 11-12, March, 1980. 4 Ref.

Descriptors: Planning, *Water quality management, Water quality, *Water pollution control, Decision making, Administration, *Regulations.

In 1977 changes were made in the Federal Water Pollution Control Act. The pollutant classification system was changed, with different deadlines and treatment requirements for each class. Construction grants for alternative and innovative technology for municipal waste treatment were increased. Increased control was imposed on sludge disposal. The states were given power to administer the construction grants and permit programs. The needs of rural counties were reemphasized. Farming and forestry activities were exempted from pollutant discharge control. Monies for institution of best management practices (BMP) on farmland were approved. Grant moves for sewer systems were limited. While considerable improvements have been noted in water quality in various areas, some areas lag behind in percentage compliance with the old deadlines of the 1972 Act. Toxic wastes were a major issue, including heavy metals, pesticides, PCBs, and other organic compounds. Advanced wastewater treatment came under fire as unduly expensive and unnecessary. Programming for the long haul is becoming more and more accepted as quick solutions to the water problem continue to fail and unreasonable expectations are ended. An all encompassing statute covering all environmental control will be proposed at some point in an attempt to bring a holistic perspective and integrated program administration to environmental affairs. (Baker-FRC)
W82-03476

COSTEL V. PACIFIC LEGAL FOUNDATION, 100 S. CT. 1095 (1980),
N. Hungerford.
Environmental Law, Vol 11, No 2, p 449-459, Winter, 1981. 67 Ref.

Descriptors: *Permits, *Legal aspects, Industrial wastes, Effluents, Decision making, *Water quality control, Water pollution sources, Legal aspects, Environmental control.

This case provided a look at the Supreme Court's view of the administrative processes by which environmental decisions are made. The narrow issue addressed in the case was whether the Environmental Protection Agency must hold a public hearing prior to extension of a permit issued pursuant to the National Pollutant Discharge Elimination System (NPDES) if it received no requests for such a hearing. The Supreme Court held that no public hearing was necessary. The implication from this decision, that the Court will narrowly construe statutory and regulatory language regarding public participation in administrative decision making including environmental decisions, is unmistakable and far reaching. The uneasy balance between public participation and agency ability to exclude the public is thus illuminated. When the Pacific Legal Foundation was begun, EPA's regulation implementing the FWPCA provided for public notice of a proposed issuance, denial, or modification of a permit. Those regulations then directed the EPA administrator to hold a public hearing on a proposed action if he found a significant degree of public interest. The regulations also allowed any interested person to request an adjudicatory hearing after EPA's decision had been made regarding a proposed action. A hearing request would be granted if it raised material issues of fact relevant to the questions of whether a permit should be issued, denied, or modified. In 1977 the expiration date of the permit issued for pollutants discharged from the giant Hyperion Wastewater Treatment Plant was extended without a hearing. A postdetermination request for an adjudicatory hearing was denied. Two petitions were filed challenging the EPA Administrator's action extending the section of the permit. The court of appeals upheld the petitions, but the decision was reversed in the Supreme Court. (Baker-FRC)
W82-03495

ECONOMICAL USE OF WATER RESOURCES.
Civil Engineer in South Africa, Vol 23, No 2, p 31, February, 1981.

Descriptors: *Water management, *Political constraints, *International agreements, South Africa, Water resources development, Utilities.

An international approach to water resources development and distribution is necessary for efficient management of water among the South African nations. Although interbasin transfers and other cooperative efforts are in practice in this region, these will become more difficult under proposed reorganization into a constellation of states unless an international nonpolitical water utility is established. The existing Rand Water Board is regional and severely constrained. (Cassar-FRC)
W82-03496

GROUNDWATER ALLOCATION MECHANISMS: THE CASE OF WESTERN KANSAS,
Kansas Univ., Kansas City. Dept. of Economics.
For primary bibliographic entry see Field 4B.
W82-03503

URBAN WATER SYSTEMS: PROBLEMS AND ALTERNATIVE APPROACHES TO SOLUTIONS,
Army Corps of Engineers, Belvoir, VA.
For primary bibliographic entry see Field 5F.
W82-03580

HOW DO YOU BUILD WHEN SEWERS ARE INADEQUATE,
Browne (Richard) Associates, Wayne, NJ.
For primary bibliographic entry see Field 5D.
W82-03592

ENVIRONMENTAL REGULATION AND CONSTRAINTS UPON SMALL HYDRO DEVELOPMENT IN CALIFORNIA, U.S.A.,
Tudor Engineering Co., San Francisco, CA.
D. S. Graham.
Canadian Water Resources Journal, Vol 6, No 3, p 295-302, 1981. 1 Ref.

Descriptors: *Environmental effects, *Regulations, *Hydroelectric plants, *California, Water rights, Water policy, Water resources development, Stratification, Reservoir, Fish, Dams.

Small hydroelectric development in California is described, with emphasis on environmental concerns and regulations. Such development is encouraged by the government, which has reduced red tape, provided loans, and screened potential sites. However, the problem of water rights is a constraint, especially in the West. In California a developer must follow both federal and state procedures with respect to environmental impact statements. These overlap considerably, so the same information can often be used for both requirements. Particular concerns in California are raptors, archeological sites, and recreation areas. Some other examples of environmental effects of small hydro development are: withdrawal of anoxic hypolimetric water through the turbine and downstream, reservoir stratification and temperature rise, disturbance to aquatic life, fish mortality in turbines, prevention of upstream migration, change of conditions in estuarine nurseries, water level fluctuations, and sediment problems, such as scouring and erosion. (Cassar-FRC)
W82-03614

HYDROELECTRIC POWER DEVELOPMENT CONFLICTS AND APPROVALS: THE ONTARIO SCENE,
Ontario Ministry of Natural Resources, Toronto.
For primary bibliographic entry see Field 6G.
W82-03616

DEVELOPMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY VOL III: STEEL MAKING SUBCATEGORY, VACUUM DEGASSING SUBCATEGORY, CONTINUOUS CASTING SUBCATEGORY CONTINUOUS CASTING SUBCATEGORY,
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 5D.
W82-03626

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY, VOL VI: COLD FORMING SUBCATEGORY, HOT COATING SUBCATEGORY,
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 5D.
W82-03629

WATER QUALITY: WHAT SHOULD BE DONE TODAY,
National Resources Defense Council, Inc., Washington, DC.
J. T. Banks, F. Dubrowski, and J. M. Warren.
February 12, 1981. 90 p, 5 Tab.

Descriptors: *Legislation, *Groundwater pollution, *Non-point pollution sources, *Toxins, Hazardous materials, Federal jurisdiction, Public policy, Public participation, Political aspects, Cost-benefit analysis, Pollution load, Groundwater management.

The National Resources Defense Council (NRDC) sees some water quality cocerns as not only critical but near-term because they arise in the context of existing legislation and agency programs, and are on the agenda for the next year or two. The major issues stressed by the NRDS, in terms of the effectiveness of existing legislation and enforcement programs, are toxic industrial discharges, non-point sources, and groundwater protection. Those who seek ways to improve the Clean Water Act during the process of Congressional reauthorization in 1981 need a high level of sophistication to address complex questions of cost-effectiveness vs. cost-benefit, rule-setting policies of the U.S. Environmental Protection Agency, federal-state jurisdictional questions and related issues of shifting economic and administrative burdens on various levels of government, and the technology-based controls needed for second-generation toxics control. Non-point source discharges have received scant attention from Congress, and legislation is needed that incorporates an adequate data base, a public constituency, and sound policy analysis. EPA's proposed groundwater protection strategy raises several major issues, such as whether the principle of non-degradation of existing groundwater quality should be adopted, at least with respect to currently pristine and drinking water quality aquifers. Another issue is the lack of available information regarding the characteristics of groundwater and the relationships between aquifers, which is necessary before any classifications can be made. Meanwhile, a coordinated program of interim measures to reduce further contamination is urgently needed. (Garrison-Omniplan)
W82-03631

CLEAN WATER ACT.
Natural Resources Lawyer, Vol 14, No 2, p 261-303, 1981. 320 Ref.

Descriptors: *Water quality, *Legal aspects, *Federal jurisdiction, Reviews, Legislation, Standards, Jurisdiction, Permits, Regulations, Clean Water Act.

Developments in the field of water quality control are reviewed for the period of 1980. The review is divided into three parts: judicial and administrative developments under the Clean Water Act (CWA), judicial administrative and legislative developments under the Safe Drinking Water Act, and judicial developments in the area of private rights of action and the federal common law of nuisance. Under the CWA, judicial activity was highlighted by four unanimous Supreme Court reversals of lower court decisions which had disagreed with the EPA's interpretation of the act. A direct challenge to industrial effluent limitations guidelines was made for the seafood processing industry. The EPA's fundamentally different factors variance clause for best practicable technology (BPT) has proven to be a source of litigation. The dissolved oxygen concentration level needed to support the fishable-swimmable use classification in Mississippi waters was also problematic. Additional activity revolved around the antidegradation policy as part of the states' water quality standards and management plans, new source performance standards, discharges of oil and hazardous substances, the hearing requirements of the NPDES permit program, the dredge and fill permit program, definition of point source, Ohio water quality standards, water quality criteria, toxic pollutant listings, enforcement, and ocean discharge criteria. (Baker-FRC)
W82-03687

CLEAN WATER ACT.
Natural Resources Lawyer, Vol 13, No 1, p 231-286, 1980. 397 Ref.

Descriptors: *Legal aspects, *Water quality standards, *Regulations, Permits, Legislation, Water pollution control, Clean Water Act, Safe Drinking Water Act, Water law, Water policy.

A review of legal aspects of water quality focuses on judicial and administrative developments concerned with the Clean Water Act, the Safe Drinking Water Act, and judicial developments in two areas: definition of navigable waters and availability of relief under the federal common law of nuisance. No substantive changes to major federal statutes took place during 1979. Circuit court decisions regarding the Clean Water Act's effluent guidelines and standards showed deference to EPA technical judgements in areas of scientific uncertainity, but contained disagreements with EPA over the need to consider economic benefits and limitations. In 1979 two cases in Oregon illustrated that EPA is making efforts to enforce the Safe Drinking Water Act against small private suppliers of drinking water. Litigation aimed at defining the term 'navigable waters' as used in the Clean Water Act is generally decreasing. The courts continue to use the broadest possible definitions. (Cassar-FRC)
W82-03688

NEW LEGISLATION IN CALIFORNIA AND ITS EFFECTS,
A. Littleworth.
In: Proceedings of the Thirteenth Biennial Conference on Ground Water, Irvine, September 14-15, 1981. California Water Resources Center, University of California, Davis, Report No 53, November, 1981. p 46-52.

Descriptors: *Legislation, *Water law, *Groundwater management, Judicial decisions, State jurisdiction, Adjudication procedure, Groundwater availability, Groundwater depletion, Groundwater storage, Permits, Prescriptive rights, Overlying proprietor, Appropriation, Pumpage, *California.

Californians are pumping groundwater faster that it can be replenished by natural or artificial recharge. In some areas the overdraft is nearly 20 percent of the total groundwater supply. Currently, California has no statutory provisions to prevent or correct overdrafts. In 1977, the Commission to Review California Water Rights Law was formed and made recommendations in three general areas of groundwater law: establishment of groundwater authority; simplified judicial procedures for basin adjudications; and groundwater authority; simplified judicial procedures for basin adjudications; and groundwater storage management. The recommendations for underground storage were generally accepted; however, the other two recommendations were seen as rationing proposals and were opposed. Various bills were introduced to codify the Commission's proposals but, with few exceptions, all of them failed. SB 95, introduced in 1981, illustrates what happened to a relatively modest proposal with essentially non-controversial reforms. It was opposed by local farming groups who feared state and judicial interference with unnecessary limitations and adjudications. The final version only provided for hazardous waste facilities after all groundwater provisions were amended out. As a result, groundwater law continues to be essentially controlled by the courts or regulated by agreements among contracting parties. The fate of SB 200 will also affect California's future. If it fails, there will be much higher energy costs for increased pump lifts and the competition for insufficient water supply will be greatly intensified. If it passes, groundwater storage will be an integral part of any development program, and could form the nucleus for more comprehensive water management. (Atkins-Omniplan)
W82-03731

SB 1391--TOWARDS A PERMIT SYSTEM FOR GROUND WATER. TOWARDS A NEW DEFINITION OF OWNERSHIP OF GROUND WATER,
G. G. Fry.
In: Proceedings of the Thirteenth Biennial Conference on Ground Water, Irvine, September 14-15, 1981. California Water Resources Center, University of California, Davis, Report No 53, November, 1981. p 12-32. 1 Append.

Descriptors: *Groundwater management, Groundwater, Water districts, *Pumpage, *Water permits, Water supply, *Water law, Legislation, Equitable apportionment, Groundwater basins, Groundwater availability, Overdraft, Aquifers, *California.

The Sierra Valley Groundwater Basin Act--SB 1391--came into being as a result of local fears that both the Sierra and Long Valleys in the Sierra Nevada mountains were being overdrafted. Excluding SB 1391, there are three broad groups to control overdraft: replenishment programs, where water is spread over the ground to artificially recharge the aquifers; in lieu programs, which pay pumpers to use an alternate to groundwater; and pump taxes, which discourage pumping. However, no authority exists that permits a district to require

pumpers to pump less. SB 1391 is unique in that it grants the management districts the authority to limit pumping and the authority to ban export under limited circumstances. During an overdraft or a time of severe water quality problems, the district can implement a permit system for groundwater management. The permit can only be instituted during a time of threatened or actual overdraft and can only be exercised by a board of directors comprised of area residents. This act also attempts to clarify the definition of overlying rights. To provide some predictability to the rights of an overlying user, the extent of ownership was redefined. It is now based primarily on the number of acres overlying the basin that a user owns, in proportion to the total number of acres overlying the basin; a figure that can be adjusted for several factors. A plan such as this has never been set forth in California before and one benefit may be to make it easier to sell groundwater between private parties. This bill is innovative and it will be some time before a discernable track record is established. The appendix contains the text of the bill. (Atkins-Omniplan)
W82-03736

THE FIFTH AMENDMENT PRIVILEGE AGAINST SELF-INCRIMINATION AND COMPULSORY SELF-DISCLOSURE UNDER THE CLEAN AIR AND CLEAN WATER ACTS,
O. A. Caginalp.
Boston College Environmental Affairs Law Review, Vol 9, No 2, p 359-395, 1981. 244 Ref.

Descriptors: *Legal aspects, *Water pollution control, Legislation, Regulations, Self-incrimination, Federal jurisdiction.

Portions of the Clean Water and Clear Air Acts require that much information regarding the pollution come as a result of self-disclosure by those doing the pollution. In both of these Acts there are statements that the information gained through self-disclosure may then be used against the alleged polluter by the government in order to identify violators and exact penalties. Questions are thus raised with respect to the applicability of the Fifth Amendment provisions concerning self-incrimination. This article describes the section of the Clean Water Act dealing with oil and hazardous substance discharges; discusses the specific case of United States v. Ward, emphasizing the factors examined by the Supreme Court in its determination of the character of the penalty provision of section 311(b); and offers a comparison of the Clean Water Act effluent limitation sections. Since the Fifth Amendment protects any one who offers evidence against prosecution only on criminal charges and not on civil charges, great significance is attached to determining whether a penalty for polluting is judged to be criminal or civil in nature. In US v. Ward, the Court first acted to determine whether Congress indicated an intention to establish a civil or a criminal penalty, and second, where Congress has indicated a civil penalty, whether the sanction was so punitive as to negate that intention. It is felt that the Ward reasoning should not be limited solely to environmental legislation, but will probably be adopted in other areas as well. (Baker-FRC)
W82-03746

GLOBAL FUTURE: TIME TO ACT. REPORT TO THE PRESIDENT ON GLOBAL RESOURCES, ENVIRONMENT AND POPULATION.
Council on Environmental Quality, Washington, DC.
Boston College Environmental Affairs Law Review, Vol 9, No 2, p 261-283, 1981.

Descriptors: *Water supply, *Resources management, *International agreements, International commissions, Organization, Administrative decisions, Administrative agencies, Policy making, Decision making, Legislation.

Demands on the world's water supply will increase steadily over the next twenty years. Especially in the Third World, severe water shortages and drought are already being felt, along with waterborne diseases. Reliable water supplies will be increasingly disrupted due to damage to watersheds, and contamination will probably increase. US development assistance efforts will be undercut, and the need for drought relief will increase. With 148 of the world's major river basins shared by two or more countries, increased conflict over water rights and usage should be expected. One major US goal is to heighten awareness of water management issues. This goal requires the development of an adequate worldwide data base, not currently available, and subsequently a coherent strategy on world water needs by region. The US contribution to solving world water problems should make use of its strengths in data collection and monitoring, pollution control, environmental assessment of water resource development projects, nonstructural alternatives to such projects, and water conservation. Bilateral technical assistance in water resource management by the US should be increased, including financial support of the United Nations for training in water management. Research efforts, international agreements, and conflict resolution arrangements should be forthcoming if the problems in water supply and demand are to be resolved. (Baker-FRC)
W82-03747

6F. Nonstructural Alternatives

BEHAVIOURAL AND POLITICAL ASPECTS OF WATER DEVELOPMENT AND IRRIGATION PROJECTS,
International Fund for Agricultural Development, Rome (Italy).
A. A. El-Sherbini.
Water Supply and Management, Vol 5, No 4/5, p 307-316, 1981. 15 Ref.

Descriptors: *Water resources development, *Planning, Social impact, Social aspects, *Political aspects, Social values, Decision making, Design criteria, Behavior, Attitudes, *Irrigation programs, Motivation.

Investment in water development and irrigation projects commands a key role in the plans of most developing countries. In many cases the emphasis has largely centered on the engineering and economic aspects of such projects. Serious neglect has occurred in the areas of behavioral and political outcomes. The continuous failure to take notice of the numerous and very real links between the socio-political structures and project behavior is an indication of a grave omission in an area crucial to project performance and success. Technical change in many cases can come about only if it is accompanied by socio-cultural transformations. Planners and policy makers frequently commit themselves to technical innovations without giving enough thought to the extent to which this commitment entrains additional changes in behavior. Behavioral and political scientists should be involved in the various phases of water projects from the identification of the problem to the implementation of the solution. The monitoring and evaluation of water development and irrigation projects should also pay special attention to these behavioral and political aspects so that problems of these natures can be rapidly detected and timely solutions found. (Baker-FRC)
W82-03579

FLOOD AREA MODELLING FROM AN ELEMENTARY DATA BASE,
Leeds Univ. (England). School of Geography.
For primary bibliographic entry see Field 2E.
W82-03581

SWMM MODEL AND LEVEL OF DISCRETIZATION,
College of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-03673

COMMENTS ON A NATIONAL GROUNDWATER PROTECTION STRATEGY,
D. H. Howells.
Ground Water, Vol 19, No 5, p 466-468, September/October, 1981.

Descriptors: *Groundwater management, *Federal jurisdiction, Governmental interrelations, Political aspects, Water management, Legal aspects, Regulations, Standards, Resources, *Water quality control.

Exception is taken to the proposed EPA groundwater protection strategy, especially the goals of the program and the adoption of classification as the principal means of implementing a groundwater protection strategy. Planning is essential, but there is no adequate way to predict the needs of the distant future. Plans must therefore be flexible and adaptable, and their consequences must not be irreversible. Decisions affecting groundwater quality are not so readily reversible as those for surface waters. Classification of water for a specific use does not assure the specified water quality. While classification of surface waters for multiple uses is conceptually sound, it becomes less so with the adoption of such goals as fishing and swimming for all the waters in the nation. The time required for upgrading groundwater sources is too long to be considered achievable. Groundwater systems are vastly more complex than surface water systems. A reasonable strategy should include delineation of important recharge areas and the prohibition of any hazardous waste activities that might threaten the quality of related aquifers. There are also institutional aspects of implementing a national groundwater protection strategy which may prove difficult. (Baker-FRC)
W82-03740

6G. Ecologic Impact Of Water Development

STRANGLEHOLD ON THE SKAGIT,
J. W. Miller.
National Parks, Vol 54, No 4, p 16-19, April, 1980. 2 Fig.

Descriptors: *Electric power industry, *Environmental effects, Dams, *Skagit River, Forecasting, Wildlife habitats, Recreation, Rivers, National parks, *Seattle, Washington, Water policy, Legal aspects.

Proposed power development by the City of Seattle on the Skagit River and its tributaries in Washington and British Columbia threaten wildlife habitats and recreation in this scenic glacial river valley, which lies between two sections of the North Cascades National Park. Several dams were built in the valley, starting early in the century when the public was not concerned with conservation. Present plans include raising the height of the Ross Dam an additional 122.5 feet, the Thunder Creek diversion project, and a dam at Copper Creek. These projects would flood miles of river valley, destroy whitewater streams used for commercial raft trips, divert Thunder Creek into a tunnel, eliminate scenic trails, and adversely affect a variety of flora and fauna, particularly the harlequin duck, bald eagle, salmon, steelhead, river otter, a grove of giant western red cedar trees, a disjunct population of the red rhododendron, and the most northwestern stand of giant ponderosa pine on the continent. A legal decision was expected in mid-1980. (Cassar-FRC)
W82-03490

ENVIRONMENTAL REGULATION AND CONSTRAINTS UPON SMALL HYDRO DEVELOPMENT IN CALIFORNIA, U.S.A.,
Tudor Engineering Co., San Francisco, CA.
For primary bibliographic entry see Field 6E.
W82-03614

INVESTIGATING WHETHER A LARGE HYDRO DEVELOPMENT CAN BE ENVIRONMENTALLY COMPATIBLE: THE SLAVE RIVER HYDRO FEASIBILITY STUDY,
Walker (R. L.) and Partners Ltd., Ottawa (Ontario).
For primary bibliographic entry see Field 6A.
W82-03615

HYDROELECTRIC POWER DEVELOPMENT CONFLICTS AND APPROVALS: THE ONTARIO SCENE,
Ontario Ministry of Natural Resources, Toronto.
L. H. Eckel.
Canadian Water Resources Journal, Vol 6, No 3, p 303-308, 1981.

Descriptors: *Environmental effects, *Institutional constraints, *Hydroelectric power, Electric power production, Dams, Energy sources, Ontario Environmental Assessment Act, Water resources development, Legal aspects, Water policy, Water law, Parks, Permits, *Ontario.

The Ontario Environmental Assessment Act will play a major role in resolving conflicts between increased demand for hydroelectric power production and the environment. The provincial government has called for an additional 2,000 megawatts of hydropower by 1995. Sixteen plants are under consideration, some new and some retrofitted. Ontario Hydro, municipalities, and private projects as included by Order of Cabinet must obtain a water power lease. Environmental impacts will be considered with technology and money by a three-member assessment board. A proper balance between unchecked development and turning every river into a provincial park will be reached. (Cassar-FRC)
W82-03616

PEACE RIVER SITE C PROJECT: ENVIRONMENTAL STUDIES; DEVELOPMENT OF A MITIGATION AND COMPENSATION PROGRAM; AND PROJECT LICENSING,
J. Waite, and H. Gruber.
Canadian Water Resources Journal, Vol 6, No 3, p 20-37, 1981. 4 Tab, 6 Ref.

Descriptors: *Hydroelectric plants, *Environmental effects, *Social impact, *Peace River, *British Columbia, Cost-benefit analysis, Compensation, Recreation, Agriculture, Planning, Wildlife, Forests, Economic impact, Water resources development, Licensing, Canada.

Possible environmental and socioeconomic effects of the proposed Peace River Site C hydroelectric project in British Columbia are: removal of 12% of agricultural land, loss of residences or outbuildings by over 60 families, change from river-based recreation to reservoir-based activity, significant losses of wildlife on the local scale, increase in most fish populations (except rainbow trout), disturbance of many of the 310 known historical sites, insignificant losses of saleable timber, and increase in social problems at Fort St. John. Principles for mitigation of and compensation for project impacts are presented. These are: (1) payments must bear a reasonable relationship to the value of the resources affected, (2) mitigation expenditures will be made if benefits exceed the costs, (3) compensation payments would be made only if local regions would suffer disproportionately to the rest of the province, (4) funding will be made to the agencies directly responsible for the resources affected, (5) funds for community service impact will be based on social costs imposed by development. An Energy Project Review Process has been established to coordinate a review of environmental and technical aspects. (Cassar-FRC)
W82-03618

THREE CASE STUDIES OF SMALL SCALE HYDRO IN NEWFOUNDLAND AND LABRADOR,
Newfoundland and Labrador Hydro, St. John's.
B. W. Bursey.
Canadian Water Resources Journal, Vol 6, No 3, p 163-177, 1981. 1 Fig 3 Tab, 9 Ref.

Descriptors: *Hydroelectric plants, *Environmental effects, Water resources development, *Newfoundland, *Labrador, Canada, Environmental Assessment Act, Fisheries, Recreation, Forests, Salmon, Wildlife, Water resources development, Case studies.

Case studies of three small scale hydroelectric plants in Newfoundland and Labrador are presented, with emphasis on environmental concerns. These plants are designed to replace oil-based generators in areas remote from accessible fuel supplies. The Roddickton Project in Newfoundland incorporated water quality sampling, a survey to determine possible effects on Atlantic salmon upstream migration, use of untreated wood to protect a downstream municipal water supply, and stream flow regulation to protect fish habitats. At the Pinware River plant in Labrador $800,000 was spent over three years to study possible impacts on fisheries, wildlife, archeological sites, forests, a provincial recreational park, and socioeconomic aspects. The probable costs of mitigating these impacts caused indefinite postponement of this project. The Dry Pond Brook project was expected to have major impacts on fisheries and wildlife and minor impacts on recreation, historic resources, aggregate resources, and socioeconomics. Three conclusions were drawn, based on the experiences gained from these studies. Small-scale hydro projects have all the elements of larger scale projects with respect to environmental concerns. Impacts are site specific. Costs of environmental surveys are proportionately larger than in large scale projects. (Cassar-FRC)
W82-03619

CURRENT ASSESSMENT OF PROSPECTS FOR FURTHER HYDRO DEVELOPMENT IN CANADA,
Walker (R. L.) and Partners Ltd., Ottawa (Ontario).
For primary bibliographic entry see Field 6B.
W82-03620

7. RESOURCES DATA

7A. Network Design

RAINFALL INTERSTATION CORRELATION FUNCTIONS. II. APPLICATION TO THREE STORM MODELS WITH THE PERCENTAGE OF DRY DAYS AS A NEW PARAMETER,
Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
For primary bibliographic entry see Field 2B.
W82-03422

ON HYDROLOGICAL DATA NEEDS IN CANADA,
British Columbia Univ., Vancouver.
M. Church, and M. Kellerhals.
Canadian Water Resources Journal, Vol 6, No 2, p 109-132, 1980. 4 Fig, 1 Tab, 31 Ref.

Descriptors: *Hydrological data collections, *Water management, Decision making, Planning, *Canada.

Concern is expressed that the data available for making decisions regarding management of Canadian water resources is not sufficient for the need. The range of information readily available in the national hydrological data base should be developed considerably. Conventional records of levels, flows, and water quality should be extended both geographically and temporally. How this is to be achieved offers considerable thought. Three substantial innovations are offered. First, analyses of hydrological data should be considerably extended and convenient means should be developed for presenting the results. Second, field procedures should be substantially modified to permit more efficient collection of data of several types, and to take advantage of technical advances in measurement. Third, the types of data collected should be expanded to include information on ice regime, river morphology and biophysical processes. Two direct benefits would accrue from these changes. First, a range of hydrobiological analyses would become available in standard form. Second, the assembly of data on river morphology and history and on biophysical processes would permit better decisions to be made about complex aspects of river management that are not eaily reducible to terms involving only actual or desirable flow magnitudes. (Baker-FRC)
W82-03443

7B. Data Acquisition

SEASONAL VARIATION IN HETEROTROPHIC ACTIVITY AND POPULATION DENSITY OF PLANKTONIC BACTERIA IN A CLEAN RIVER,
Hull Univ. (England). Dept. of Plant Pathology.
R. Goulder.
Journal of Ecology, Vol 68, No 2, p 349-363, July, 1980. 7 Fig, 2 Tab, 36 Ref.

Descriptors: *Bacteria, *Seasonal variation, *Population density, Rivers, *Hull River, *England, *Heterotrophic bacteria, Allochtonous bacteria, Plankton.

Heterotrophic activity (as indicated by glucose mineralization), density of total bacteria, mean activity of individual bacteria, and density of viable bacteria were measured in the unpolluted River Hull, England, at 2-week intervals from January 1975 to December 1976. Heterotrophic activity was highest in summer. This can be explained by the high density of total bacteria and by high activity of individual bacteria. Low heterotrophic activity in winter was a result of low density and low activity of individual bacteria. Densities of total bacteria, obtained by direct counting, were 0.34-2.91 million per ml at Wansfor Bridge (fast-flowing water) and 0.32-4.38 million per ml at Bethell's Bridge (slowly-flowing water) and were roughly coincident with the heterotrophic activity values. A combination of high temperature and low river discharge produced the high densities of total bacteria found in summer, and high temperatures produced the high summer activity of individual bacteria. Since density of total bacteria and discharge or rainfall were not positively correlated, allochthonous bacteria were not important. The density of viable bacteria was very variable and showed no seasonal pattern. (Cassar-FRC)
W82-03405

INADEQUACIES IN THE TECHNIQUE OF RESISTIVITY METHOD FOR LOCATION OF WATERWELL SITES IN HARD ROCK AREAS,
Center for Water Resources, Madras (India).
P. N. Ballukraya, R. Sakthivadivel, and R. Baratan.

Descriptors: *Resistivity, *Exploration, *Groundwater availability, *India, Electrical studies, Water yield, Well yield, Wells, Rock testing, Water resources development, Drilling, Geohydrology, Granite, Gneiss.

The electrical resistivity method for locating groundwater has been inadequate in the hard rock region of south India. Water in this granite and gneiss bedrock is in two types of zones: decomposed rock and joints and fractures. Vertical sounding curves obtained at 17 sites near Bangalore, India, were matched against theoretical model curves and analyzed by the inverse slope method. The results did not agree well with actual driller's logs. There were no satisfactory correlations between the resistivity values and water yield. Thickness of overburden was usually underestimated by the resistivity measurements. (Cassar-FRC)
W82-03412

ENVIRONMENTAL ISOTOPES AS A TOOL IN HYDROGEOLOGICAL RESEARCH IN AN ARID BASIN,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). In for Desert Research.
For primary bibliographic entry see Field 2F.
W82-03415

A PORTABLE APPARATUS FOR THE MEASUREMENT OF RATE OF FLOW BY THE LITHIUM-TRACER METHOD,
Yorkshire Water Authority (England).
T. T. Rimmer.
Water Pollution Control, Vol 80, No 3, p 411-412, 1981. 1 Fig, 1 Tab, 1 Ref.

Descriptors: *Measuring instruments, *Flow measurement, *Tracers, Flow, Flow rates, Lithium, Rivers, Water treatment facilities.

An apparatus is described that was designed to contain and supply a predetermined, constant flow of lithium chloride solution. This apparatus is completely portable, needing no outside power source. The lithium chloride solution is contained within a 25 liter plastic aspirator which is pressurized by a foot-operated air pump. The outlet at the base is connected to an automated flow-control device which gives a constant pressure at the outlet. The discharge of solution is controlled and monitored by means of a rotameter. The Flostat is designed to work at low pressures of 50-150 mm Hg, but the discharge is difficult to monitor if the pressure exceeds this level. The scale on the gapmeter is calibrated from 50 to 800 ml/min of water at 20 degrees C. The flow rate must be measured accurately on site on each occasion to ensure that errors due to solution viscosity/temperature are not introduced. A practical example is given of this apparatus, used to check the flow recorded at a sewage treatment plant. (Baker-FRC)
W82-03428

AN EVALUATION OF THE SEDIGRAPH AS A STANDARD METHOD OF SEDIMENT PARTICLE SIZE ANALYSIS,
Hydrological Research Inst. Pretoria (South Africa).
A. V. B. Weaver, and D. C. Grobler.
Water SA, Vol 7, No 2, p 79-87, April, 1981. 7 Fig, 3 Tab, 19 Ref.

Descriptors: *Particle size, *Sediments, *Measuring instruments, Sedimentology, Performance evaluation, Reproducibility, Hydrology.

Various tests were performed to evaluate the applicability of the sedigraph as a standard instrument for particle size distribution analysis. The effects of varying concentrations, and the effects of cell size, reproducibility and accuracy were investigated. Using the sedigraph reduced measurement time considerably, and it gave results with good repetition. Also, it produced results in close agreement with standard samples. There were discrepancies in the results obtained with the sedigraph, pipette, hydrometer, and sedimentation balance methods, but microscopic analysis of the samples tended to support the results obtained with the sedigraph. The sedigraph is suggested as the standard tool for the measurement of sediment particle size distribution. Sediment particle size is an extremely important measurement in many areas of hydrological research. (Small-FRC)
W82-03437

PARTICLE COUNTER FOR SEDIMENT TRANSPORT STUDIES,
Washington Univ., Seattle. Dept. of Oceanography.
J. P. Downing, Jr.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1455-1465, November, 1981. 7 Fig, 1 Tab, 10 Ref.

Descriptors: *Measuring instruments, *Sediment transport, Bottom sediments, Sand, Acoustics, Electrochemistry, Particle size, Particle shape, Particle counters, *Bed load.

This paper reports the development of an acoustic instrument that measures bed load transport by responding to the direct impacts of sand-sized sediment particles entrained in the bed load layer. The instrument consists of an electromechanical transducer for the detection of particle impacts and an electronic circuit that shapes the transient signals produced by impacts into digital pulses and counts them. The transducer is rugged and physically small, and preliminary field evaluations indicate that the instrument is potentially useful for measuring bed load transport rates in natural flows. By virtue of the principle of particle detection, spurious response of the sensor to silt, clay, biological material, and air bubbles is negligible. The instrument may have application to the problem of local bed load measurement in natural transport systems. Due to the difficulties resulting from the dependence of the instrument output on grain momentum, the best results will be obtained in natural systems with well sorted bed material in the size range from .00975 to .078 inches, with grain velocities exceeding 0.60 meters/second and high transport rates. Other applications include laboratory studies of sediment transport in pipes and flumes and investigations of wind blown sand. The output of the instrument can be transmitted in digital form with only minor modifications to the electronics. In this way, the count-rate values would be recorded directly and more efficient processing of laboratory and field data would be possible. (Baker-FRC)
W82-03666

USE OF VISIBLE AND THERMAL SATELLITE DATA TO MONITOR AN INTERMITTENTLY FLOODING MARSHLAND,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research.
G. F. Byrne, K. Dabrowska-Zielinska, and G. N. Goddrick.
Remote Sensing of Environment, Vol 11, No 5, p 393-399, November, 1981. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Marshes, *Remote sensing, Monitoring, *Satellite technology, *Australia, Flood control, Water level, Flood profiles, Soil water, Soil-water-plant relationships.

Selected thermal and visible data from the Heat Capacity Mapping Mission satellite for the Macquarie Marshes of Eastern Central Australia were examined in the light of a substantial volume of data from other sources, including Landsat, with a view to evaluating meteorological satellite data as ecological monitors for this landform. It is apparent that at least four dominant components of the marshland scene can be mapped using HCMM imagery. These include free water - high thermal admittance, poor coupling for heat transfer to the atmosphere; woodland - low thermal admittance, good coupling to the atmosphere; soil or grass covered soil - lower thermal admittance, poor coupling to the atmosphere; and scald - low thermal admittance, poor coupling, and low soil water content, because of infiltration rate. The ecological status of such scenes is intimately linked with their water status, and a consideration of visible and thermal imagery with appropriate spatial resolution appears to be an economical and effective means of monitoring such systems. Such imagery would, in the long term, provide insight into changes occurring from week to week, insight which could be acquired by ground parties only with great difficulty. The work of a single ground party would be considerably more effective if carried out with a background knowledge of the current status of various components of the system. (Baker-FRC)
W82-03682

COMPARISON OF RESULTS OBTAINED WITH THE VIDIAZ SPECTROPLUVIOMETER AND THE JOSS-WALDVOGEL RAINFALL DISDROMETER IN A 'RAIN OF A THUNDERY TYPE',
Institut et Observatoire de Physique, Clermont-Ferrand (France).
For primary bibliographic entry see Field 2B.
W82-03707

DEVELOPMENT OF A SOIL MOISTURE MODEL FOR USE WITH PASSIVE MICROWAVE REMOTE SENSORS,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W82-03715

8. ENGINEERING WORKS

8A. Structures

THE NEW ENERGY BOOM: SMALL-SCALE HYDROPOWER,
A. Seltz-Petrash.
Civil Engineering (New York), Vol 50, No 4, p 66-71, April, 1980. 2 Fig.

Descriptors: *Hydroelectric power, *Electric power production, *Dams, Regulations, Construction, Financing, Utilities.

Retrofitting older, small dams to produce hydropower is feasible in about 10% of the nation's 50,000 dams. Although there are drawbacks (small size, typically 5 MW, drop in production in low flow and ice conditions, and high cost of custom made equipment), there also are advantages. Hydropower is renewable and clean, has well-understood technology, has a short time from inception to production (1-5 years), operates with few personnel, and has little environmental impact. In Phase 1 of a Department of Energy program, 7 pilot studies and 22 construction projects were begun in 1978. Phase 2 involves funding to encourage municipalities and private developers to become involved in small-scale hydropower. Several New England manufacturers have redeveloped existing low capacity hydropower on their sites for internal use. Some utilities such as Niagara Mohawk, New York, have begun developing hydropower. Hydropower redevelopment will most likely continue to grow. However, it will probably only contribute between 5 and 17% of the nation's total electrical needs. In certain areas it can be a significant power source, especially for manufacturers. Present hydropower costs per installed kW capacity are $300-$2000. (Cassar-FRC)
W82-03462

PUMPED-STORAGE FOR SWISS RAILWAYS, PART ONE,
Swiss Federal Railways, Bern.
P. Rochat, and J-L. Mottier.
International Water Power and Dam Construction, Vol 32, No 2, p 54-59, February, 1980. 5 Fig, 2 Tab.

Descriptors: *Pumped storage, *Railroads, *Water supply, Storage, Dam construction, Reservoirs, *Switzerland.

A pumped-storage system was added to the independent hydroelectrical supply system for the Swiss railroads. At the Chatelard-Barberine plant, a compensating basin with an active storage volume of about 200,000 cu m was constructed. The new station consists of two vertical-axis units with Pelton turbines and generator motors with an overall rating of 80 MVA. There is room for two storage pumps, but only one, with a discharge of 4 cu m/sec and a capacity of 31 MW, was installed. Construction of the Chatelard-Village compensating basin added an artificial reservoir with active storage capacity of 203,000 cu m and a total volume of about 250,000 cu m. The dams which form the basin have a maximum height of 35 m above the foundation level and consist of granitic and gneissic rock. Construction of the dam included several geotechnical tests, and compaction during construction was checked by determining the in-place density using the sand-cone and nuclear methods. The settlement of the foundation under the main dam was recorded using a Telemac settlement gauge with a vibrating wire and an instrument of the communicating-tube type. Eight benchmarks were surveyed to study deformations in the dam after filling of the basin. (Small-FRC)
W82-03468

GROUND WATER MONITORING: PART II,
T. Gass.
Water Well Journal, Vol 35, No 5, p 38-40, May, 1981. 5 Fig, 2 Ref.

Descriptors: *Monitoring, *Groundwater, Water supply development, Water resources develop-

ment, Groundwater management, Groundwater pollution, Wells, *Well design criteria.

Critical design components of a monitoring well are examined, especially as it relates to well design and methods of extracting a sample. The characteristics of a given aquifer have a part to play in the design of the monitoring well system. The spacing, depth and even the drilling and installation methods used for the wells are to some extent determined by the characteristics of the aquifer. Types of monitoring wells include wells with intakes through a single vertical interval, piezometers and observation wells, well clusters, and single well-mulitple sample points. Wells screened over a single vertical interval of an aquifer are one of the most commonly designed and constructed wells for obtaining water samples from unconsolidated or semiconsolidated formations. The major drawback in using individual wells or piezometers screened over a single vertical interval of an aquifer is that they provide no information pertaining to the vertical distribution of the contaminant and only rudimentary information on its areal distribution. Use of well clusters to define the vertical distribution of a contaminant is one alternative. Use of single wells with multiple sampling points will also yield excellent information on the vertical distribution of a contaminant, but only when the sampling zones are carefully sealed from one another within the well and the annular space. (Baker-FRC)
W82-03484

EASTERN SCHELDT DESIGN HAS CHANGED.
Civil Engineering (London), p 47, October, 1981.

Descriptors: *Storm surges, *Barriers, *Environmental effects, *Fisheries, Storm tides, Eastern Scheldt, *Netherlands.

In order to protect the environment and fisheries in the area, the design of the storm surge barrier on Holland's Eastern Scheldt was changed. The original design called for closing the area off from the sea. The present design includes sliding gates in three tidal inlets which will be closed only during bad weather. The project is a large one consisting of 66 concrete piers 35 to 45 m high, each weighing about 17,500 tons. Problems experienced during the project included the necessity of compacting the seabed so it can support the pier footings and establishing pier footings. Pier footings will be embedded in dumped rock to resist the strong currents in the area. Six Dutch construction firms are working on the project, which began construction in 1979. (Small-FRC)
W82-03493

USE OF COMBINED CYCLIC-CONTINUOUS TECHNOLOGY IN EARTH-DAM CONSTRUCTION,
A. I. Churakov.
Hydrotechnical Construction, No 1 p 12-18, January, 1980. 6 Fig, 5 Tab, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 1, p 8-12, January, 1980.

Descriptors: *Conveyance structures, *Dam construction, *Rock excavation, Excavation, *Earth dams, Rockfill dams, Quarries.

The most common transport system for constructing earth dams combines trucks with conveyor belts in a 3-phase set-up. Motor vehicles transport quarry material to a storage hopper, a conveyor belt moves it to a hopper located at the dam, and trucks carry the fill to the dump site. Greatest efficiency is reached at a freight turnover of 3000-6000 tons per hour and a haul distance of 4.5-5.0 km. If large rocks exceed 3% of the total mass, conveyor output changes. Supplementary crushing is carried out when 20-25% of the material is too large for transport (400 mm). An example of rock transport for a mining enrichment plant is given. When the conveyor system approaches design capacity, considerable savings are realized. (Cassar-FRC)
W82-03498

HYDRODYNAMIC EFFECTS IN DYNAMIC RESPONSE OF ARCH DAMS,
California Univ., Berkeley.
C. S. Porter.
PhD Thesis, December, 1980. 331 p, 43 Fig, 2 Tab, 27 Ref, 9 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-13167.

Descriptors: *Hydrodynamics, *Arch dams, *Mathematical models, Structural behavior, Earthquakes, Concrete dams, Water resources development, Design criteria, Dynamic response, Ground motions, Impounded water.

The objective of this work was to study the dynamic structural behavior and response of arch dams to ground motion, with special emphasis on identifying hydrodynamic effects in the response behavior. The substructure method has been adapted and generalized for response analysis of arch dams subjected to upstream-downstream, cross-stream and vertical components of ground motion. The arch dam and impounded water are treated as two substructures of the total system and displacements of the dam are represented as a linear combination of the first few natural modes of vibration of the dam alone. Responses to arbitrary ground motion can be obtained by Fourier synthesis procedures applied to the complex frequency response functions determined by the analysis procedures presented. The analysis procedure permits the effects of structure-fluid interaction to be included rationally in dynamic response of arch dams. Dam-water interaction, considering water compressibility, affects the radial acceleration response of dams to upstream-downstream and cross-stream ground motions to a similar degree. However, the response to vertical ground motion is greatly increased by these effects. Just as in the case of gravity dams, vertical ground motion causes significant hydrodynamic pressures. These pressures act in the horizontal plane on a cylindrical dam face, thus causing significant additional response. The additional hydrodynamic forces causes by bank motions in the upstream-downstream or cross-stream directions may significantly affect the dynamic response of arch dams at some excitation frequencies. (Sinha-OEIS)
W82-03509

PROJECT REPORT, PLANNING AND DESIGN DEVELOPMENT KAW POINT WASTEWATER TREATMENT PLANT, KANSAS CITY, KANSAS,
S Kansas Univ., Lawrence. School of Engineering and Architecture.
For primary bibliographic entry see Field 5D.
W82-03525

MATHEMATICAL MODELING OF EARTH DAM BREACHES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
W. C. Lou.
PhD Thesis, 1981. 238 p, 66 Fig, 11 Tab, 128 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-19715.

Descriptors: *Model studies, *Mathematical models, *Earth dams, *Dam failure, Sediment transport, Bank erosion, Slope degradation, Hydrographs, Flood discharge, *Teton Dam, *Mantaro Dam.

A mathematical model has been developed in order to predict the outflow hydrograph of earth dam breaches. The model is based on the water continuity and motion equations, the sediment continuity equation, a sediment transport equation and a breach form equation. In addition, another simple model was developed considering the Corps of Engineers - Schoklitsch discharge formula and Cristofano's approach for embankment erosion. The sediment transport discharge is considered according to two different approaches. The mechanism responsible for the breach formation is studied considering a section of greatest efficiency from the erosional stand-point, in which the geometric characteristics are functions of a new parameter: the embankment angle of repose. The second-order quasilinear hyperbolic system that includes continuity and motion equations, is implicitly solved by a four-point scheme in the space-time plane, considering the reservoir and a rating curve as boundary conditions upstream and downstream respectively. The spatial and temporal variations of the breach are combined with the unsteady water model yielding discharge and area along the embankment in each time step. The total sediment transport is explicitly calculated resulting in a new embankment profile, taking into consideration the updated boundary conditions. The validity of the mathematical models was checked by applying them to two actual earth dam failures: the Teton Dam and the Mantaro Dam. Good agreement was obtained between the model and the observed data. (Sinha-OEIS)
W82-03532

HIGHLIGHTS OF THE ST. MARY'S REDEVELOPMENT PROJECT,
L. H. Anderson, and K. Overbeeke.
Canadian Water Resources Journal, Vol 6, No 3, p 197-242, 1981. 16 Fig, 3 Tab.

Descriptors: *Environmental effects, *Hydroelectric plants, *Construction, St. Mary's River, Saulte Ste. Marie, *Ontario, Bulb turbines, Alternative planning, Planning, Water quality.

The St. Mary's Redevelopment project at Sault Ste. Marie, Ontario, is an example of redeveloping existing hydroelectric facilities installed between existing station, ice sluiceway, dikes, seepage cutoff trench, concrete gravity retaining wall, and deeper approach channel. Three horizontal bulb unit generators are scheduled to go on line starting August 1982. Advantages and disadvantages of seven alternatives for supplying the required power were evaluated. The environmental concerns were the waterfront, nature and recreational parks, archeological findings on Whitefish Island, a potential shipping canal, preservation of St. Mary's River rapids, fish remedial works, water quality, aquatic life, shoreline erosion, navigation, and restoration of borrow areas for construction materials. (Cassar-FRC)
W82-03617

DICKSON DAM, ALBERTA - THE 20 MW POWER FACILITY,
R. J. Simpson, and J. P. Sengupta.
Canadian Water Resources Journal, Vol 6, No 3, p 178-196, 1981. 4 Fig, 5 Tab.

Descriptors: *Hydroelectric plants, *Dam design, *Dickson Dam, Red Deer River, *Alberta, Diversion structures, Economic aspects, Benefits, *Cost-benefit analysis, Hydraulic structures, Design criteria, Reservoirs, Powerplants, Environmental effects.

An $18 million, 20 MW 2-unit power facility was added to the plans for construction of the $112 million Dickson Dam on the Red Deer River, Alberta. The dam and its flow regulating structures were originally designed to provide a minimal seasonal regulated flow of 16 cu m per sec and to improve water quality. The design intakes for the 530 m twin diversion tunnels were enlarged slightly and the gate system modified for use as power tunnels. The break-down point for net benefits vs. capital construction occurs at a mill rate of 20.8 per kwh. The environmental benefits produced by the original plans are not expected to change due to the addition of the powerplant. The structures are expected to be in service in 1983. (Cassar-FRC)
W82-03621

UNCERTAINTIES IN WATER DISTRIBUTION SYSTEMS,
D. A. Clarke, E. A. McBean, and S. A. Al-Nassri.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY10, p 1263-1267, October, 1981. 1 Fig, 10 Ref.

Descriptors: *Water distribution, *Pressure distribution, *Pipes, *Design criteria, Water mains, Pipelines, Mathematical studies, *Water supply systems.

As a means of examining the uncertainties in the design of a water distribution system, the sensitivity of the pressure difference is examined using the First Order Analysis method. The sensitivity of the pressure differential was examined across a pipe due to uncertainties in a mathematical model, discharge, hydraulic slope exponent, and Hazen-William's coefficient. These results were used to obtain a required accuracy of measurement devices for providing meaningful results in field measurement of pressure differentials along sections of distributed mains. Uncertainties in the input data of water distribution networks were substantial and could lead to meaningless results. (Small-FRC)
W82-03668

EFFICIENT COOLING PONDS: DESIGN,
Cornell Univ., Ithaca. School of Civil and Environmental Engineering.
G. H. Jirka, C. F. Cerco, and D. R. F. Harleman.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1547-1563, 1981. 9 Fig, 2 Tab, 11 Ref.

Descriptors: *Cooling ponds, *Design criteria, Thermal water, *Powerplants, Thermal pollution, Heated water, Ponds, Cooling ponds, Circulation, Hydrodynamics.

The design of cooling ponds for the dissipation of waste heat from steam-electric power plants is considered, keeping in mind steady-state performance and transient performance. Particular emphasis is put on the design of shallow ponds, as defined by classification criteria proposed earlier, which lack a predominant vertical stratification and are dominated by the through flow hydrodynamics. Such ponds are frequently built by kiking or excavating an offstream land area. A schematic laboratory study was performed to test the effect on pond performance of various design measures, notably internal baffle arrangements, discharge structures and a deep intake reservoir. An optimal pond design is suggested with moderate baffling to prevent recirculation zones, a radial discharge structure to minimize entrance mixing, and deep intake reservoir with a residence time of at least one half day to insure damping of diurnal intake temperature fluctuations. A moderate length/width ratio of 5-10 will require some amount of internal baffle to prevent recirculation zones. Given a common rectangular shape of available land, a U-shaped pond is frequently most attractive and a good tradeoff against the increased costs of a more dense baffle arrangement. (Baker-FRC)
W82-03672

SEDIMENTATION CONTROL IN INDIAN RESERVOIRS,
Edinburgh Univ. (Scotland).
E. J. McKeogh.
International Water Power and Dam Construction, Vol 33, No 10, p 41-43, October, 1981. 3 Fig, 6 Ref.

Descriptors: *Reservoirs, *Sedimentation, *Sediment control, *India, Dams, Soil erosion, Sediment transport.

The scale and complexity of the sedimentation problem in Indian reservoirs is discussed using data collected from as far back as 1870. Two basic approaches exist for sedimentation control: controlling soil erosion and handling sediment where it creates the problem. The first approach is preventive in nature, involving agronomic practices and management of vegetation. The second approach involves engineering measures. Sediment can be removed by various means, determined largely by the degree of sediment removal required. Conventional devices such as ejectors and vortex tubes have been used to remove sediment from canals, but only with partial success. The sediment removal system in use at the Baira Siul hydroelectric project in Himachal Pradesh is detailed. Large boulders are trapped in a recirculating zone and subsequently removed through the gates. Medium sediment is removed through a tunnel which emanates from the base of the channel. The remaining silt-laden flow is directed to a desilting basin. The average efficiency of the basin was found to be 94.5%. A description is also offered of the Trisuli power channel at the hydroelectric project in Nepal. Several devices for sediment exclusion from the canal were considered, from which a settling tank with flushing arrangement was selected for testing. (Baker-FRC)
W82-03693

OPTIMAL RISK-BASED DESIGN OF HYDRAULIC STRUCTURES,
Texas Univ. at Austin.
Y-K. Tung.
PhD Thesis, August, 1980. 420 p, 59 Fig, 41 Tab, 70 Ref, 9 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-00978.

Descriptors: *Hydraulic structures, *Model studies, Hydrologic aspects, Hydraulic models, Risks, Safety, Economic aspects, Statistical methods, Cost-benefit analysis, *Design criteria, Optimization, *Risk-based design.

A general framework for evaluating the risk and reliability of water resource engineering projects is developed which takes into account the uncertain features involved in both hydrologic and hydraulic aspects and parameter uncertainties. In most water resource engineering projects the evaluation of risk is limited to the consideration of the inherent hydrologic uncertainty while the hydrologic model and parameter uncertainties and the hydraulic uncertainties are ignored. This report illustrates that ignoring these additional uncertainties can lead to serious underestimates of the associated risks and consequently, underestimate the associated economic losses and safety hazard. First-order analysis is used to estimate the uncertainty of deterministic hydraulic models which have uncertain parameters. A new methodology for treating (minimizing) the hydrologic parameter uncertainty is developed that uses generalized parameter (mean, standard deviation, and skewness) values from a weighting between sample and regional hydrologic information. The methodology uses either of two nonparametric statistical techniques, the jackknife or the bootstrap, to determine variances of the sample parameters, and regression analysis is used to determine variances of the sample parameters. The hydrologic model uncertainty is treated using a weighting procedure by assigning a weight to various probability models considered. The generalized parameter estimates and the observations of sample data are both used. By doing so a composite probability model can be developed to define risk and reliability which reduces the uncertainty of adopting the probability model. (Sinha-OEIS)
W82-03710

8B. Hydraulics

PARAMETRIC STUDY OF FLOOD WAVE PROPAGATION,
Indian Inst. of Science, Bangalore (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W82-03425

NUMERICAL SIMULATION OF RESERVOIRS,
Brown Univ., Providence, RI. Div. of Applied Mathematics.
For primary bibliographic entry see Field 6A.
W82-03504

MODEL-PROTOTYPE COMPARISON OF FREE SURFACE VORTICES,
Worcester Polytechnic Inst., Holden, MA. Alden Research Labs.
G. E. Hecker.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY10, p 1243-1259, October, 1981. 1 Fig, 4 Tab, 28 Ref.

Descriptors: *Vortices, *Model studies, *Prototype tests, Hydraulic models, Flow, *Intakes, Eddies.

Past research on vortices and scale effects is reviewed and a new summary of model versus prototype observations is provided regarding vortex intensity. The data summary indicates that sufficient operating problems due to vortices have occurred to warrant reasonable efforts to minimize vortices at intakes. When hydraulic models operated at Froude-scaled flows are used to predict vortex intensity some scale effects occur, while some increase in model flows above Froude-scale values may eliminate these. Large increases, however, are not justified and may result in model distortion. In models with Froude-scaled flows which predicted only swirls and surface dimples, negligible scale effects were found. In this case, no air vortices would occur in the prototype. (Small-FRC)
W82-03667

BUOYANT SURFACE JETS,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
G. H. Jirka, E. E. Adams, and K. D. Stolzenbach.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1467-1487, 1981. 11 Fig, 1 Tab, 45 Ref.

Descriptors: *Dimensional analysis, *Jets, Hydraulics, Buoyancy, Plumes, Model studies, Thermal pollution, Heated water, Discharge measurement, *Fluid mechanics.

The fluid mechanical properties of buoyant surface jets entering various types of receiving waters are discussed. Then jet properties, such as mixing capacity and geometric scale, are defined using dimensional analysis, and these are then quantified through combined used of integral jet model predictions and field or laboratory observations. Not only are such relationships useful as initial estimates to define discharge behavior, mixing efficiency, regions of influence, and parametric sensitivity of different discharge design alternatives, but the results define limits of applicability of buoyant surface jet models. One application may be the establishment of criteria on transition distance and on bottom and shoreline attachment which can thus be used in the selection of appropriate predictive models. The study indicated that for deep stagnant receiving water, the buoyant jet has a certain transition length which is used to define the near field zone, a maximum penetration depth, and a limited dilution capacity which is predominantly met through bottom entrainment. These parameters are found to scale with a densimetric Froude number based on kinematic momentum and buoyancy fluxes and characteristic source length. A definition for shallow receiving water conditions is given on the basis of observation of reduced entrainment. Increasing shallowness decreases the jet mixing capacity and increases the length of bottom contact. A criterion is presented to distinguish free shoreline attached buoyant surface jets in crossflowing receiving water. A simple trajectory relation appears to describe the deflection of surface buoyant jets in crossflowing deep receiving water. (Baker-FRC)
W82-03670

UNIFORM FLOW CALCULATIONS FOR PIPES,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
D. I. H. Barr.
Civil Engineering (London), p 15, 17, 21, 30, June, 1981. 3 Fig, 17 Ref.

Descriptors: *Pipe flow, *Mathematical studies, *Graphical analysis, Uniform flow, Turbulent flow, Laminar flow, Channel flow.

Non-dimensional auxiliary scales are presented for direct solutions for each of the basic pipe flow problems. This method has inherent accuracy in terms of solution of the Colebrook-White function and involves only one diagram. It covers a wider range of flow circumstances than the Akers method and places the solution within the context of the familiar resistance diagram. These procedures are not bounded by the limitation of applying only to rough turbulent conditions, as past

methods have been. These cover transition turbulent and smooth turbulent flow as well as laminar and laminar-turbulent transition flows. The diameter of equivalent pipe concept is used rather than the hydraulic mean depth as adopted by Akers, because the equivalent diameter integrates better with the mainstream of resistance diagram and numerical solution practice. This method is an alternative for both pipe and open channel problems which provides valuable elements of direct representation and visualization of the flow circumstances involved. (Small-FRC)
W82-03748

8C. Hydraulic Machinery

CONTINUOUS ION EXCHANGE: DESIGN CALCULATIONS,
M. J. Slater.
Effluent and Water Treatment Journal, Vol 21, No 10, p 461, 464-466, October, 1981. 3 Fig, 14 Ref.

Descriptors: *Ion exchange, *Design criteria, Resins, Fluidized bed process, Wastewater treatment, Water treatment, Fluidized beds, Packed beds, Filters.

Assessment is made of the design principles for packed and fluidized bed ion exchange plants, both fixed bed and continuous flow systems. Use and validity of laboratory experiments in the generation of data for large plants are discussed. The relationship between packed and fluidized types of operation is demonstrated by analytical design equations. Axial mixing of liquid fluidized beds is considered, and its impact on scale-up is demonstrated. It is concluded that binary systems are amenable to mathematical interpretation with some simplification, and multi-component systems can be simulated by computer if all the relevant equilibrium and kinetic data are determined. Fluidized bed systems suffer mixing of liquid and resin, which can be characterized sufficiently well to demonstrate the importance of changing flow patterns on scaling-up and the need to justify use by treating dirty liquids. (Baker-FRC)
W82-03623

8D. Soil Mechanics

DETERMINING OF SEISMIC EARTH PRESSURE ON A RIGID RETAINING WALL,
B. M. Bakhtin, and V. K. Nguen.
Hydrotechnical Construction, No 1, p 70-77, January, 1980. 4 Fig, 1 Tab, 11 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 1, p 41-45, January, 1980.

Descriptors: *Seismic properties, *Dam stability, *Retaining walls, Soil mechanics, Dam failure, Hydraulic structures, Earthquakes, Soil pressure.

A method for calculating the seismic earth pressure on a retaining wall, such as a dam, is proposed. If a rigid wall prevents movement of the earth, the energy of a seismic wave will be manifested as a dynamic earth pressure on the wall. It is expected that the pressure on a rigid retaining wall would be maximum near the top and decrease approaching the base. The results of calculations using the Construction Norms and Regulations method and the Rukhadze method (1965) were considerably different from those obtained using the method developed in this paper. Investigations on a plaster model of a retaining wall 10 cm high, 5 cm at the crest, 20 cm at the base, and 100 cm long showed that the diagram of the intensity of the seismic earth pressure had the form of an inverted triangle with the vertex at the base of the wall. The seismic pressure of cohesionless soil on a rigid wall was more dependent on the elastic characteristics of the soil medium and less on the angle of internal friction. The standard methods of determining loads from seismic earth pressure underestimated the design volume of the wall by 5-7%. According to calculations, the most likely type of failure for walls during earthquakes is overturning. This is consistent with reported cases of wall failure. (Cassar-FRC)
W82-03497

8E. Rock Mechanics and Geology

MODEL STUDIES OF AN OVERTOPPED ROCKFILL DAM,
M. Gerodetti.
International Water Power and Dam Construction, Vol 33, No 9, p 25-31, September, 1981. 6 Fig, 11 Ref.

Descriptors: *Dam stability, *Cofferdams, *Gabions, Rockfill dams, *Model studies, El Cajon, *Honduras, Hydraulic structures, Anchors, Overflow.

Results of tests and design concepts for the rockfill cofferdam at the El Cajon hydroelectric project in Honduras are described. Specifications stated that the 40 m high cofferdam, with steel sheetpile center wall, must withstand overtopping. Gabions are used to protect the downstream surface and part of the upstream side. In scale model tests unanchored gabions allowed severe disruption of the embankment at low flows. Inserting anchors protected the dam from high flows and from seepage water, which is significant. It is important that the grain size of stones in the gabion be filled with material coarser than the mesh. (Cassar-FRC)
W82-03694

8G. Materials

FILTER CRITERIA FOR SUB-SURFACE DRAINAGE,
B. Harrison.
Civil Engineering (London), p 22, 24, 26, April, 1981. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Drainage systems, *Subsurface filters, Design criteria, *Filters, Filtration, Drainage, Drainage engineering, Subsurface drainage.

The use of lightweight, easily placed and cost effective filter membranes of geotextiles replaced the need for costly graded aggregate filters for several purposes. In the United States their original use was as an alternative to graded natural filters beneath rip-rap on coastal protection schemes. Use has spread to pipe and aggregate wraps for subsurface drains, separators for temporary or permanent roads, filters for piezometer tips and well screens, drainage blankets to sports fields, components of reinforced earth construction and others. It is noted that too conservative an approach, depicted as using small mesh or pore opening sizes, may be unacceptable for long-term filtration performance. The only geotextile filter criterion released to date that allows for the controlled passage is the Trammel filter criterion, based on the Elmer curve. Allowing maximum mesh opening size while maintaining adequate retention and providing sufficient open areas minimizes the risk of clogging. (Baker-FRC)
W82-03660

CAVITATION-RESISTANT GUNITE COATINGS FOR HYDRAULIC STRUCTURES,
L. N. Gomolko, I. S. Novikova, S. V. Sharkunov, and G. N. Tsedrov.
Hydrotechnical Construction, No 6, p 587-589, June, 1980. 2 Fig, 1 Tab, 2 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 28-29, June, 1980.

Descriptors: *Gunite, *Cavitation, *Hydroelectric plants, *Hydraulic structures, *Materials engineering, *USSR, Water conveyance, Conduits, Concrete technology, Tunnel linings, Linings, Coatings.

Gunite showed increased cavitation resistance as compared with conventional concrete in laboratory tests. The composition of gunite mixtures and the cavitation erosion in grams per hour were as follows: gunite-sand (1:2), cement grade 300, 0.75; 1:3 mixture, cement grade 300, 2.53; 1:4 mixture, cement grade 300, 2.90; 1:2 mixture, cement grade 400, 0.38; and cement grade 400 without gunite, 0.76. Cavitation was produced by a rod 20 mm in diameter at stream velocities of 27 m per sec. This corresponds to the velocity of water near the wall in a water conduit, where the average flow is about 40 m per sec. (Cassar-FRC)
W82-03677

8H. Rapid Excavation

USE OF COMBINED CYCLIC-CONTINUOUS TECHNOLOGY IN EARTH-DAM CONSTRUCTION,
For primary bibliographic entry see Field 8A.
W82-03498

8I. Fisheries Engineering

EASTERN SCHELDT DESIGN HAS CHANGED.
For primary bibliographic entry see Field 8A.
W82-03493

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

PROFESSIONAL DEVELOPMENT FOR WATER QUALITY CONTROL PERSONNEL,
Ohio State Univ., Columbus.
C. L. Shepard.
PhD Thesis, 1980. 149 p, 13 Fig, 28 Tab, 127 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-22345.

Descriptors: *Education, *Professional personnel, *Water quality control, Wastewater treatment, *Continuing education, Questionaires, Personnel requirements.

Generalizations based on the findings of this study must take into account the particular samples of respondents, the nature of the survey instrument, and the procedures used to analyze the data. However, in view of the information yielded, certain conclusions seem warranted. There is a significant lack of educational opportunities for the professional development of water quality control personnel. The response regarding available education opportunities is not consistent with the amount of participation indicated by personnel. There are differences among the states in their approach to water quality control and requirements for operations personnel. Employee classification, education level, and municipal size as variables are related to participation in, familiarity with, and importance attached to continuing education-professional development opportunities. There are areas of common agreement on the education opportunities relevant for water quality control personnel across employment classifications. There are differences between supervisors and technicians in the overall rankings for educational opportunities. The respective rankings of each group coincide directly with job responsibilities. The survey methodology provides a usable technique to collect information from water quality control personnel regarding relevant educational opportunities. Wastewater treatment plant personnel can be surveyed for the purpose of obtaining data on relevant educational opportunities for water quality control personnel. (Sinha-OEIS)
W82-03531

9B. Education (In-House)

TRAINING PROGRAMMES FOR BETTER WATER MANAGEMENT IN SURFACE IRRIGATION PROJECTS IN INDIA,
Mahi-Kadana Irrigation Project, Ahmedabad (India).
T. K. Jayaraman.
Water Supply and Management, Vol 5, No 3, p 261-272, 1981. 2 Fig, 2 Tab, 17 Ref.

Group 9B—Education (In-House)

Descriptors: *Irrigation projects, *Management, Planning, Training, Water resources development, Water supply, Water supply development, *India.

A serious problem which has adversely affected the performance of irrigation projects in India has been a lack of professionalization in water management tasks. One of the two suggested solutions to this problem calls for providing training programs for the project personnel serving in the spheres of operation and maintenance and irrigated agriculture extension and production. The programs visualized are for both in-service personnel and those entering the projects as fresh recruits. A training institution is to be located in a representative command area. Once these programs are initiated and run, the other solution of setting up a separate water management cadre becomes obvious and easier to implement as a logical sequel to the training programs. (Baker-FRC)
W82-03434

10. SCIENTIFIC AND TECHNICAL INFORMATION

10B. Reference and Retrieval

STORAGE AND RETRIEVAL OF GROUNDWATER DATA AT THE U.S. GEOLOGICAL SURVEY,
Geological Survey, Reston, VA. Water Resources Div.
M. W. Mercer, and C. O. Morgan.
Ground Water, Vol 19, No 5, p 543-551, September/October, 1981. 7 Fig, 2 Tab, 10 Ref.

Descriptors: *Information systems, *Data collectionss, *Groundwater, Information retrieval, Data storage and retrieval, Computers, Wells, Springs, U.S. Geological Survey, National Water Data Exchange.

A computerized groundwater site inventory (GWSI) file, maintained by the U.S. Geological Survey, contains information on wells and springs at 770,000 sites (as of February 1981) throughout the U.S. This hierarchically structured data base is part of the central water resources data file known as National Water Data Storage and Retrieval System (WATSTORE). Data input is reviewed for accuracy before being entered into the file. Indexed information is stored randomly on a disk file. Among the many types of information in the file are location, construction, geology, water quality, and production. Data is retrieved by a natural language system or by a backup system in a higher program language. Users may request information by computer or by writing the U.S. Geological Survey at Reston, Virginia, or at any of 58 assistance centers listed in a table. (Cassar-FRC)
W82-03649

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